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Changes in Anthropometric Measures of Wellbeing in Korea from 1945 to 1977: Evidence from Korean Military Records

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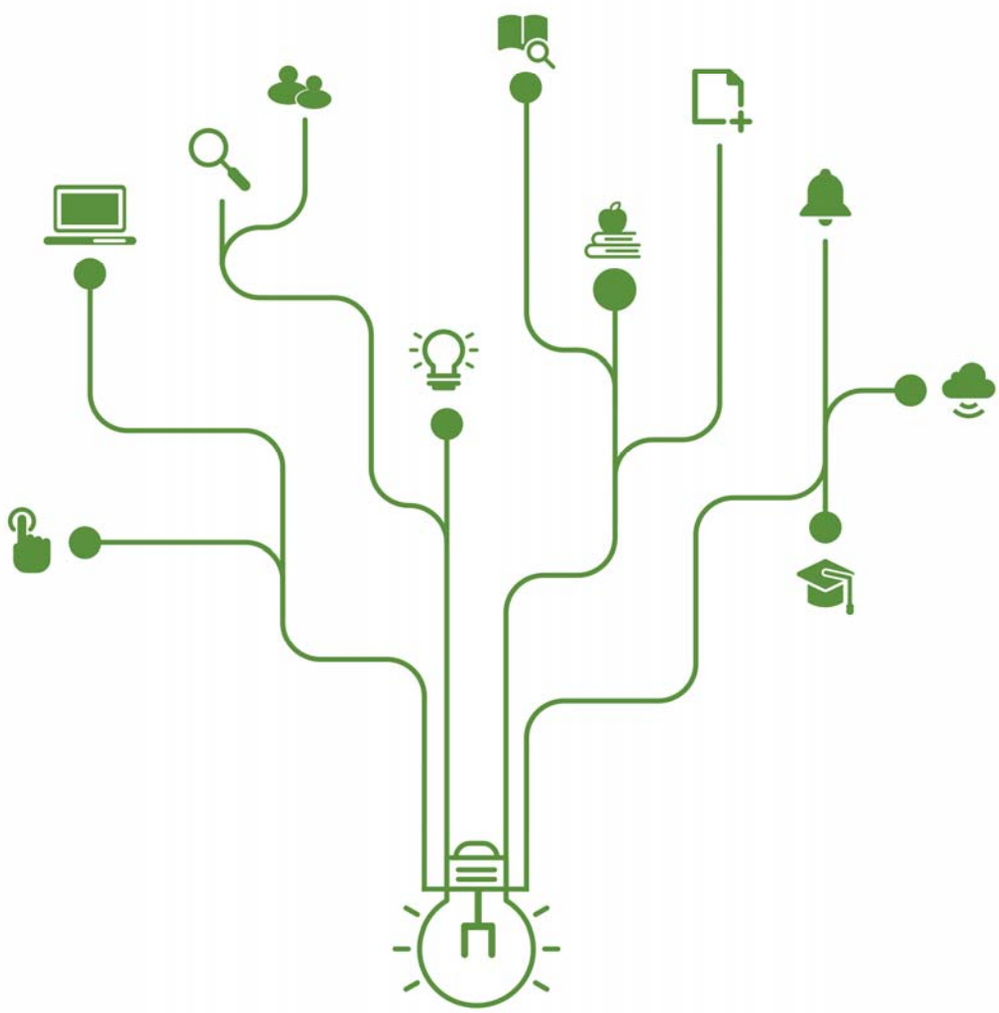

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Title
Changes in Anthropometric Measures of Wellbeing in Korea from 1945 to 1977: Evidence from Korean Military Records

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Executive Summary

Although it is widely acknowledged that the rapid economic growth in South Korea during the second half of the twentieth century improved the standards of living of the population, it is not fully understood how the living conditions in South Korea changed over time, and what are the major factors that produced the changes. Research on these issues is often seriously limited by shortage of appropriate data, especially for the period between 1945 and 1960. The present study attempts to overcome the limitations of currently available data on standards of living by analyzing a newly collected sample of Korean military records. Using these sources, we have investigated how biological indices of standards of living, such as height, weight, and body-mass-index (BMI) changed across birth cohorts born between 1946 and 1957. We also examined how changes in anthropometric measures differed by province of residence, father's occupation, and own education.

The mean height of 20-year-old males in South Korea slightly declined from the 1946 birth cohort to those born in 1951, before it rapidly increased across cohorts. As for the average weight, a sharp decline and recovery of weights around the first two years of the

1) I thank Minyoung Do for her excellent research assistance and the participants of a preliminary seminar, especially Taejong Kim and Myeongho Park, for their helpful comments. I gratefully acknowledge the financial support of KDI School through the Development Economic History program. Any remaining errors are my own.

Korean War (1950 and 1951) is observed. These results suggest that the Korean War likely affected significantly the anthropometric measures of the birth cohorts who experienced the war in utero or in early childhood.

There were considerably large variations across provinces in the patterns of changes in anthropometric measures as well as the levels of the measures. Generally speaking, men who resided in Seoul and other metropolitan cities (Busan, Daegu, Gwangju, Daejeon, and Ulsan) are taller than those from non-metropolitan provinces. In contrast, men from the majority of non-metropolitan provinces are significantly shorter than those from Seoul. In sharp contrast to the results for height, urban disadvantages in weight are observed.

The results of regression analyses show that the observed provincial differences in anthropometric measures do not disappear even if father's occupation and own education are controlled. Consistent with the urban advantages found in provincial differences in height, the children of farmers turned out to be shorter that the offspring of non-farmers. Own education is positively associated with height and weight. These results suggest that the observed regional differences in the level and trend of biological standard of living in South Korea prior to the mid-1970s were probably produced by provincial differences in socioeconomic and environmental characteristics.

It will be the next step of this research project to explore what are the major factors that produced the secular changes and regional differences in biological standards of living in South Korea prior to the 1970s. We are currently in the process of collecting and inputting county-level variables that are believed to be associated with net nutritional status of the population, including agricultural production, urbanization, and industrialization. We plan to conduct additional analyses by adding these factors on local environments to the variables on personal characteristics utilized in this study. We anticipate that the results of these further analyses will allow us to determine what socioeconomic changes or policy measures were the major contributors to the improvements of wellbeing of the Korean people.

Introduction

It is widely acknowledged that the rapid economic growth in South Korea during the second half of the twentieth century greatly improved the standards of living of the country's population. As will be surveyed in the next chapter in detail, available evidence pertaining to measures of human wellbeing, such as per capita income, life expectancy, and heights, all suggest that Koreans today enjoy much higher levels of material wellbeing compared to those who lived in the country 70 years ago.

Even with this general consensus on the long-term trend in the standards of living, however, it is not fully understood how the living conditions in South Korea changed over time, and what are the major factors that produced the changes. For instance, there is still much to be learned about how the process of improvements differed by socioeconomic characteristics, and about how the experiences of each birth cohort differed with each other. We do not fully understand how particular economic or social progress affected the wellbeing of the population, either.

In-depth research on these issues is often seriously limited by shortage of appropriate data, especially for the period between 1945 and 1960. We can obtain reasonably large and representative micro data on household incomes and consumption expenditures only for the period after the 1970s. Many of the previous studies that utilized biological measures of standards of living were based on recent survey data including aging birth cohorts, which are subject to some shortcomings such as selective survival of healthier individuals and shrinkage of heights at older age. Other studies of its kind relied on relatively smaller samples of particular demographic groups in the past, which makes it difficult to generalize the results for the entire population. Furthermore, the vast majority of the sources used by these studies do not allow us to infer socioeconomic backgrounds and ecological environments of individuals in growing ages.

In this study, we attempt to overcome these limitations of currently available data on standards of living in South Korea prior to the 1970s by analyzing new data on Korean military records that were collected from the Military Manpower Administration. These sources provide a relatively large sample of males who were born between 1946 and 1957. Because all males in South Korea are subject to military conscription, and because military records are produced for those who are exempted from service, the sample is arguably representative of each male cohort of military service age in South Korea. The information available from the data include anthropometric measures such as height and weight at age

20 along with the outcomes of conscription medical examinations. Parental socioeconomic characteristics such as father's occupation as well as own socioeconomic variables can be obtained, too.

Using the new data, we study how biological indices of standards of living, such as height, weight, and body-mass-index (BMI, hereafter) changed across birth cohorts born between 1946 and 1957.[2] In addition, we examine how the overall levels and changes across cohorts in the measures of wellbeing differed by province of residence (Chapter 4). Finally, we conduct regression analyses to investigate how parental and own socioeconomic characteristics were related to anthropometric measures. Based on regression results, we explore what produced the provincial differences in height and weight changes (Chapter 5). Before presenting the results of empirical analyses, we first introduce previous studies on the standards of living in South Korea from its liberation in 1945 to the mid-1970s (Chapter 2) and the data on Korean military records this study is based upon (Chapter 3).

Previous Studies on Standards of Living in South Korea between 1945 to 1975[3]

Changes in Conventional Measures of Material Wellbeing

Aggregate national income or production indices such as GNP, GDP, GNI, and GDI are perhaps the most widely used indices of average standards of living of a country. Available estimates for South Korea suggest that the real GDI and GNI per capita stagnated by the early of 1960s, and then rose rapidly in the following years ([Figure 2-1]).

Several historical studies present have estimated the real GDP per capita for the period from 1945 to the mid-1950s.[4] For example, Cha (2014: 27-28) provided a long-term trend of the real GDP per capita (in the 1990 international Geary-Khamis dollar) by using the Maddison Database. Kim (2012: 323-325) pointed out some errors in the Maddison data, and employed a used new methodology to estimate the trend of the real GDP per capita

2) BMI is defined as the ratio of weight in kilograms to height in meters squared.

3) The statistical data or research referred to in this paper provide the secular trends in real rather than nominal measures, and per capita rather than gross measures, which represent one's welfare status better.

4) Official statistics constructed for the period between 1940s and 1950s are relatively scanty as Japanese administrators who had lived in the colonial Korea ran away in a hurry to their home country after defeat in 1945. From 1945 to 1948, US Army Military Government in Korea (USAMGIK) governed the Southern Korea in the political chaos. During the 1950s, the Korean War and its consequences hampered the working of the Korean government system.

between 1911 and 2010. Pyo (2001: 96) restored missing values of the real GDP per capita from 1945 to 1952 by using econometric method of estimating missing observations to produce a continuous long-term trend ([Figure 2-2]). They all demonstrate that the real GDP per capita (or real GDP / employment) stagnated by the early of 1960s, and then started to rise rapidly in the following years.

We can infer standards of living based on real wages and incomes received by individuals. According to some official statistical data on regular employees in electricity, gas, and water-work industry or finance and insurance industry (National Statistical Office 1998: 105; Bank of Korea 2005: 72), college-educated workers and male workers received higher real wage than the high school graduates and female workers, respectively. These statistics also suggest that real wage premium associated with education and gender widened between 1970 and 1975 ([Figure 2-3] and [Figure 2-4]). National Statistical Office (1998: 111, 135) also offered a number of data on income and consumption of both urban and rural households ([Figure 2-5]). In the early of 1960s, farm households received higher incomes and consumed more than nonfarm households. But the situation reversed in the middle of 1960s. From the early of 1970s, as the average income and consumption levels of farm households increased sharply, the gaps between farm and nonfarm households narrowed.

The trends of educational wage gaps provided by National Statistical Office (1998:106) are similar to those provided by Cha et al. (2014: 94). Cha et al. (2014) estimated educational wage gaps in Korean financial industry from 1922 to 2011 using micro-data provided by the Ministry of Labor. According to the results, the wage discount of workers with primary school education vis-a-vis high school graduates contracted, whereas the wage premium enjoyed by university over high school graduates widened from mid-1960s to 1975. They also suggested that supply-side increase of secondary education resulted in the changes.

Other studies provide results on wage or income disparities by socioeconomic status during the period from 1945 to 1975. Cha (2001) estimated daily rice wages of unskilled workers from 1739 to 1992, and Gini coefficients from 1950 to 1990. Cha (2014) also provided the secular trends of three indices of living standards, namely, real wage index, welfare ratio, and rice wage. Ahn (1997) analyzed long-term changes in income distribution in Korea. These studies suggest there were no relative improvements of the standards of living of the poor by the early- or mid-1960s in Korea.

Alternative measures of standards of living include indicators pertaining to sanitation,

public health, and medical expenditure that have been widely used in determining the wellbeing of individuals in developing countries. Although the evidence on these measures drawn from Korea is still scanty, a few official statistical data suggest some improvements in public health provisions and health status of the population. First of all, population per a physician or pharmacist sharply decreased by the early 1960s, and then remained stable ([Figure 2-6]). Daily water supply per person rapidly increased in the late 1950s and the 1960s ([Figure 2-7]). The number of community health centers (bogeonso) greatly increased in the late 1950s (<Table 2-1>). There were considerable improvements in public sanitations by 1960 (<Table 2-2>). These pieces of circumstantial evidence suggest that advances in public health conditions were probably well under way prior to 1960 in South Korea.

Changes in Biological Standards of Living

Nutritional status of the population at large or lower classes is one of key measure of standard of living, especially in the past and in less developed countries. A large number of studies have estimated indices of food consumption or caloric intakes. Anthropometric variables such as height, weight, and BMI have been widely used as measures of net nutritional status that allow researchers to infer the size of claims on nutrition as well as the amount of food intakes.

According to official statistics provided by National Statistical Office (1998: 238), the amount of food supply increased from 1960 to 1970, and then stagnated during the first half of the 1970s ([Figure 2-8]). The magnitude of animal food supply increased from 1960 to 1975 both absolutely and relative to that of vegetable foods. [Figure 2-9] provides the total caloric intake along with the provisions of protein and fat per capita. The results are matched well with the changes in animal and vegetable foods over time. The caloric intake increased during the 1960 and then remained stable like the total food supply. Meanwhile, the amounts of protein and fat supplies continuously increased between 1960 and 1975. Kim et al. (2000) confirm that the amount of animal food consumption increased whereas grain consumption gradually declined over time. Their study also suggests that the size of carbohydrates as a percentage of the total energy supply decreased whereas that of fat gradually increased since 1940.[5)]

Height is a primary index of cumulative net nutritional status during growing ages.

5) The results of Kim et al. (2000) are somewhat different from those of National Statistical Office in that the relative importance of protein remained stable over time.

Official statistics suggest that the heights in childhood and adolescence began to increase at least from the mid-1960s ([Figure 2-10]; <Table 2-3> and <Table 2-4>). A few studies provide evidence as to the long-term trends as well as socioeconomic differences in anthropometric measures of wellbeing in Korea prior to the 1970s. The data and measures of biological standards of living used in some of those studies are summarized in <Table 2-5>. Some studies make comparisons across different birth cohorts (Hong et al., 1993; Hwang et al., 2003; Schwekendiek and Jun, 2010; Pak et al., 2011; Sohn, 2016) whereas another line of works largely concern with changes in age-specific anthropometric measures across different years (Lim et al., 1986; National Statistics Office, 1998; Pak, 2004; Lee and Park, 2005; Kim et al., 2006; Kim et al., 2008; Choi and Kim, 2012; Korean Agency for Technology and Standards, 2015).

The studies on cohort-specific stature generally show that the heights of Korean people increased from the cohorts born after 1945, with substantial differences across birth cohorts and across demographic characteristics observed. Hwang et al. (2003) found that height increase was slower for the 1940-1959 birth cohorts and the 1960-1969 birth cohorts, based on a small sample of females included in the Ansan Health Study. Sohn (2016) also maintained that the trend of male heights was rather flat for the cohorts who experienced the Korean War and its aftermath in childhood. Hong et al. (1993) suggested that the population size of the place of residence was positively related to the heights of girls of menarcheal age.

Differences in height growth by gender and age group have been found by the studies based age- and year-specific measures. For the period between 1965 and 1975, the biggest height change was found at age 7 for both boys and girls (Kim et al. 2008; Choi and Kim 2012). Increase in average height in infants and younger children occurred more visibly during the period 1966-1984, which experienced a very rapid economic development in Korea (Kim et al. 2008; Choi and Kim 2012). Kim et al. (2008) reported that the heights in all age group between 12 and 24 stagnated between 1945 and 1950s, and then rapidly increased afterwards. Lee and Park (2005) found that the stature of children aged 6 to 11 stagnated or declined between 1953 and 1966.

It has been established that the body weights of Koreans increased over time, too. Again, the trend in weight gains of Korean appears to differ by demographic characteristics. As in the case of heights, the average weight of girls of menarcheal age was positively related to the population size of the place of residence (Hong et al., 1993). Kim et al. (2008) found that body weights between ages 12 and 24 stagnated between

1945 and 1950s, and then rapidly increased thereafter. The average BMI of the Korean population shows an increasing tendency. However, there were clear gender differences in the trends of BMI. The male average BMI rapidly increased (<Table 2-6>), whereas the female BMI only modestly increased (<Table 2-7>).

Although vital statistics prior to 1970 are not highly reliable, it appears that the average life expectancy sharply increased between 1960 and 1970 ([Figure 2-11]). There were substantial fluctuations in the rates of morbidity and mortality caused by acute infectious disease from 1946 to 1954, but a long-term declining trend emerges had there not been for the short-term fall and rise in 1948 and an increase in 1951 ([Figure 2-12]). Age at menarche is often used as an index of biological standard of living. Several studies found that menarcheal age of Korean girls declined especially after 1946 (Hong et al., 1993; Hwang et al., 2003; Sohn, 2016).

Military Records in Korea

After a large-scale recruitment was attempted on a compulsory basis following the outbreak of the Korean War, military service is a mandatory duty for all males in South Korea. All males have to take physical examinations for military conscription at age 20. Military record cards are produced for all males including those who are exempt from service. On the front page of the card, the information on personal and family characteristics as well as the results of physical examinations is recorded. For veterans, military service records are provided on the back page of the card.

The carded military records (CMR, hereafter) are kept in the central office of the Military Manpower Administration (MMA, hereafter). For the years from 2002 (for the birth cohorts born in 1982 or later), CMRs are available in machine-readable forms. For earlier birth cohorts, either image files or micro films of military records can be obtained. Judging from the total number of records, it appears that CMRs are available for the entire male population at least from the mid-1960s.

By obtaining permission from the MMA, we collected a 0.5% sample of CMRs for the birth cohorts born from 1946 to 1957.[6] The CMRs for the individuals born from 1948

6) Our original plan was to collect a 2% sample for the cohorts born from 1946 to 1982 for whom a representative sample of CMR can be obtained from the MMA and whose CMRs are not in machine-readable forms. Because of constrains on time and research fund, we chose to reduce the sample size and to focus on birth cohorts who were born prior to the beginning of post-war industrialization in Korea for whom micro-level data covering early-stage of life course are much scantily available.

and 1957 are contained in the forms of image files that can be sorted according to the National Registration Number of which first six digits provides the birth dates. We selected men who were born in the 20th day of each month and whose ID ends with 4 or 6, which gave a one in 150 sample. Further selections of records that are complete and readable provided us with a roughly 0.5% sample. For the birth cohorts born from 1946 to 1948, the CMRs are available in the forms of micro films. We selected the first 15 films from each roll composed of 3,000 films for these cohorts. If the selected film is incomplete or difficult to read, we replaced it by the next film.

To protect privacy of the individuals included in the sample, we deleted the following information from the selected CMRs: 1) the names of the conscript and family members, 2) military ID, 3) last seven digit numbers of National Registration Number, and 4) address below the level of county or district. The front and back pages of CMRs with the sensitive personal information deleted were scanned at the MMA, and we obtained the resulting image files. After duplicate records were detected and excluded, we inputted the information drawn from the image files into database.

We identified nine different types of CMRs in terms of format and content. Four major types, denoted as Form 1 to Form 4, account for the vast majority of the sample. The variables pertaining to the information on conscripts that available from all types of CMR include birth dates, place of current residence, place of original residence, education, occupation, specialty, results of physical examinations and aptitude tests, and conscription decision. The data also provide information on the age, occupation, relationship to the conscript of parents (or guardian) and other family members. The variables on physical examinations include height, weight, chest measurement, blood pressure, eyesight, and particular health problems.

<Table 3-1> presents the number of samples by birth year. The total number of CMRs collected and scanned at the MMA is 18,359. Of these CMRs, we found 21 records with a missing page, and 233 duplicated records. After excluding these defected records, 18,115 CMRs were inputted into machine readable forms. The sample size for each birth cohort ranges from 1,031 (the 1947 birth cohort) to 2,211 (the 1957 birth cohort). Of these 18,115, we selected men whose height and weight at the time of medical examination are reported and whose place of residence or origin (Bonjeok) is available.

Changes in Anthropometric Measures across Times and Regions

Changes in Height and Weight across Birth Cohorts

[Figure 4-1] shows how the average height of military conscripts changed from the subjects of the 1946 birth cohort to those born in 1957.[7] A stark contrast between the years 1946 to 1951 and the period from 1951 to 1957 stands out. The mean height slightly declined from 165.8 centimeters for the 1946 cohort to 165.5 for the 1950 and 1951 birth cohorts. Afterwards, Korean men became taller at a considerably rapid pace. The mean height increased by more than two centimeters in just 6 years. It is particularly remarkable that the average height jumped by 0.9 centimeters between 1951 and 1952.

[Figure 4-2] presents the weights (in kilograms) of men who were born between 1946 and 1957. Instead of secular trend, as found for the average height, a sharp decline and a recovery of weights around the first two years of the Korean War (1950 and 1951) is observed. Compared to the weights of the cohorts born prior to 1949 or after 1951 (58.3 kilograms or heavier), the males born in 1950 (57.6 kilograms) or 1951 (57.3 kilograms) were distinctively lighter. This sharp drop was followed by a rapid rebound between 1951 and 1953: the average weight increased by nearly 0.9 kilograms within two years. The cohorts born from 1952 to 1957 do not show a clear tendency in weight changes.

[Figure 4-3] provides how the average BMI changed across birth cohorts born from 1946 to 1957. Between 1948 and 1950, the mean BMI fell as the average weight sharply declined whereas the average height stagnated. From 1950 to 1953, the average BMI recovered from the drop to some extent, as the rapid increase in the mean height was dominated by strong rebound in the average weight. In the following three years, the increase in heights and stagnation in weights produced a decline in the mean BMI.

The results presented in [Figure 4-1] to [Figure 4-3] suggest that the Korean War likely affected significantly the anthropometric measures of the birth cohorts who experienced the war in utero or in early childhood. Previous studies found that prenatal exposure to the Korea War, especially during the first 10 months (June 1950 to April 1951) in which war-caused damages to civilians were concentrated, negatively affected health and socioeconomic outcomes at older ages (Lee, 2014; Lee, 2016). A possible mechanism by which early-life exposure to the war affects adult outcomes is the effects of wartime hunger that could adversely affected fetal growth. Maternal stress caused by war-related disruptions such as exposure to combat activities and bombing could negatively

7) The values of average heights are reported in Appendix Table A1.

affect fetal health, too.

Consistent with the prediction of the "Fetal Origins Hypothesis," we observe much lighter weights of the cohorts born in 1950 or 1951, who spent at least a part of their prenatal period during the worst 10 months of the war, compared to the neighboring birth cohorts. Similarly, the heights of the men born in 1950 or 1951 are located below a smooth long-term trend in height across cohorts. The results of this study provide some additional insights to the related studies. First, it looks like early-life exposure to the Korean War had more powerful negative impacts on weight than it had on height. Second, exposure to the war shortly after birth might have some adverse effects on weight, as suggested by a noticeable decline in weight experienced by the 1949 birth cohort who experienced the Korea War in infancy.

Differences in Anthropometric Measures across Provinces

How do the levels of and changes in anthropometric measures differ by province where conscripts spent their childhood and adolescence? To answer the question, we computed anthropometric measures for each province and for four birth cohorts, namely, 1946-1948, 1949-1951, 1952-1954, and 1955-1957. The grouping of birth cohorts is based on the results that the 1949-1951 birth cohorts were negatively influenced by the Korean War, and the outcomes of the cohorts born in the following three years exhibit recovery from the shocks. We chose not to look into year-to-year changes for each of provinces to avoid small sample size.

[Figure 4-4] presents the average height for each group of birth cohorts and province. Substantial differences across provinces are observed in both the level at a point of time and the pattern of change over time. For the cohorts born prior to 1949, men from Gwangju (166.2 centimeters) were the tallest, followed by those from Busan (166.1 cm), Chungnam (166.1 cm), and Gyeongnam (166.0 cm). By contrast, the conscripts from Jeju (163.4 cm), Gangwon (164.7 cm), and Jeonbuk (164. 7 cm) were relatively short. Excluding the men from Jeju whose sample size is relatively small, the difference between the top and bottom provinces is about 1.8 centimeters.

The patterns of height changes over time substantially differ across provinces, too. The difference in the average height between the 1946-1948 and 1955-1957 birth cohorts is about 1.6 centimeters. Particularly rapid increase in stature is observed among the conscripts from Jeju (3.9 cm), Gwangju (2.2 cm), Gangwon (2.2 cm), and Jeonbuk (2 cm). By contrast, the pace of the increase in heights was relatively slow among males from

Gyeonggi (1.2 cm) and Gyeongbuk (1.3 cm). Leaving aside Jeju with a relatively small sample size, the difference in the magnitude of height change between the top and bottom provinces is as wide as one centimeter, about two thirds of the average for the entire sample.

[Figure 4-5] provides how the average weight of men from each province changed across birth cohorts. As in the case of heights, provincial variations in weights are substantially large. As for the 1946-1948 cohorts, the mean weight ranges from 56.2kg (Gwangju) to 61.0 kg (Jeju). Other provinces with relatively heavy conscripts include Chungnam (58.8 kg), Gyeongnam (58.7 kg), and Gyeongbuk (58.7 kg).

The average weight of the entire sample did not change much between the 1946-1948 and 1955-1957 birth cohorts: it increased only by 0.14 kg. However, provincial differences in weight changes across cohorts are substantial. For example, The average weight increased by more than one kilogram between the two groups of birth cohorts in Ulsan (1.12 kg), Jeonnam (1.09 kg), and Daegu (1.05 kg). In contrast, several provinces experienced a considerable decline in average weight, including Gyeongbuk (-.0.73 kg) and Chungbuk (-0.32 kg).

[Figure 4-6] presents changes in the average BMI across birth cohorts by province. During the three years following the liberation from the Japanese occupation, the mean BMI was particularly high for men from Jeju (22.7), Jeonbuk (21.6), and Gangwon (21.6) that are the bottom three provinces in terms of mean height. Relatively low BMI is observed among the conscripts from Gwangju (20.5), Daejeon (20.9), Incheon (20.9), and Ulsan (20.9).

Overall, the average BMI fell from 21.2 for the 1946-1948 cohorts to 20.9 for the 1955-1957 cohorts. Jeju (-0.91), Chungbuk (-0.61), and Gyeongnam (-0.54) experienced a particularly large decline in BMI among their conscripts. In contrast, the mean BMI increased by 0.4 among men from Gwangju; and it remained little changed among the conscripts from Ulsan.

Regression Analyses

Provincial Differences in Height and Weight

The results of the preceding chapter show variations in height and weight across provinces are substantially large for the cohorts born from 1946 to 1957. The results raise

a question of what produced such regional variations in anthropometric measures. A question related to this larger issue is whether the provincial differences in anthropometric measures resulted from the regional disparities in individual socioeconomic characteristics or differences in local environments that are related with human growth.

We conduct regression analyses for examining if the provincial variations in height and weight can be explained by differences in individual socioeconomic status. A key proxy variable for SES is father's occupation. We first identified the group of conscripts whose father is not reported in the CMR (father absent). We then classified father's jobs for those providing information on fathers into sex categories: 1) farmer, 2) professional, 3) clerical, 4) manual, and 5) no job. In addition, we consider the educational attainment of the males at the time of conscription, which is classified into the following five groups: 1) primary school or less; 2) middle school graduates; 3) high school graduates; 4) college or higher; and 5) education missing.

<Table 5-1> provides the results of OLS regressions for heights in which the two variables on SES explained above as well as dummy variables for provinces are included as independent variables. Three specifications are employed for regressions. In model 1, we included only province dummy; father's occupation is added to model 2, and model 3 includes father's occupation and own education along with province dummy variables.

he estimated coefficients for the dummy variables for provinces show how the average height of the men from each province compares with that of men from Seoul (the omitted category). Generally speaking, men who resided in Seoul and other metropolitan cities (Busan, Daegu, Gwangju, Daejeon, and Ulsan) are taller than those from non-metropolitan provinces. The only exception is the conscripts from Incheon, one of the seven metropolitan areas, whose average height is significantly shorter than the dwellers in Seoul. The heights of males from other metropolitan cities are not statistically different from that of Seoul residents. In contrast, men from the majority of non-metropolitan provinces are significantly shorter than those from Seoul. If the variables on SES are not controlled (model 1), all but one non-metropolitan province (Gyeongnam) shows significantly negative coefficient. The provinces with particularly short mean heights include Jeju (-1.9 cm), Gangwon (-0.76), and Incheon (-0.75).

Consistent with the urban advantages found in the estimated coefficients for province dummy variables, the children of farmers turned out to be shorter. If education is not controlled (model 2), the conscripts whose fathers were employed in professional, clerical, and service jobs were significantly taller than the sons of farmers by 1.7 cm, 1.4 cm, and

0.5 cm, respectively. Own education has a strong positive relationship with stature. Men who had some college education were 2.3 cm taller than those with primary school education or less. If education is controlled (model 3), the advantages of having father with nonfarm occupations remain, although their magnitudes become smaller.

The results of similar regressions conducted for weight are reported in <Table 5-2>. In sharp contrast to the results for height, urban disadvantages in weight are observed. The coefficients for province dummy variables are all positive, except for Incheon; they are statistically insignificant for metropolitan cities with an exception of that for Ulsan, which is marginally significant (p-value is 0.0634). The coefficients for the dummy variables for non-metropolitan provinces are all positive and statistically significant for seven out of nine provinces. The provinces with particularly heavy conscripts include Jeju (1.43), Jeonnam (1.21), Gyeongnam (0.95), and Chugnam (0.83). It is notable that the men from Incheon are much shorter and lighter than the rest of the sample at the same time.

The sons of men engaged in non-farm elite occupations (professional, clerical, and service) are statistically no different from the sons of farmers in terms of weight. The conscripts having fathers who had a manual job and whose occupation is not reported are significantly lighter than the sons of farmers. On the other hand, as in the case of height, own schooling is positively associated with weight. The conscripts with some college education are about 1.3 kg heavier than those with primary school education or less, if father's occupation and province of residence are held constant.

We conducted similar regression analyses separately for the groups of birth cohorts who were born between 1946 and 1948 and those born between 1955 and 1957 to examine if the patterns of provincial differences in height and weight changed across different cohorts. <Table 5-3> presents the results obtained from estimating model 2. The results suggest that provincial differences in height and weight substantially changed across birth cohorts. As for height, although the average stature of each province relative to that of Seoul (indicated by the signs of the coefficients for province dummy variables) remains unchanged for the majority of provinces, the magnitude and statistical significance of each coefficient were altered substantially. In case of weight, the signs of coefficients for province dummy variables change for many regions as well as their magnitudes.

Provincial Differences in Changes in Height and Weight

The results of Chapter 4 suggest that there were substantial variations across provinces in the patterns of changes in anthropometric measures as well as the levels of the

measures. The results also show the heights and weights of males who were born during the Korean War declined during the Korean War. The same question raised for the levels of height and weight can be applied to changes in anthropometric indices, that is, if the provincial differences in changes in anthropometric measures resulted from changing regional disparities in individual socioeconomic characteristics or changing differences in characteristics of localities.

To answer this question, we investigate how the magnitude of change in average height or weight between the pre-war birth cohorts 脈born from 1946 to 1948) and the post-war cohorts 脈born between 1955 and 1957) differ across provinces if parental and personal characteristics are controlled. For this purpose, the following regression equation is estimated:

$$(1) \quad y_i = \alpha + \beta_1 I_i + \Sigma_j \gamma_j P_{ij} I_{ij} + \delta X_i + \varepsilon_i$$

In equation (1), yi denotes height or weight of the person, Ii dummy variable indicating the person was born between 1955 and 1957, Pij dummy variable indicating the person was from province j, Xi variables on parental and personal characteristics, and εi error term. Dummy variable for Seoul was omitted as the metropolitan city was chosen as the control group. The subjects of the birth cohorts who were born from 1949 to 1954 were excluded from the analysis to compare the pre- and post-war birth cohorts, eliminating possible temporal effects of the Korean War. The variable of interest in this analysis is the interaction term of province dummy and the dummy for the post-war birth cohorts. The coefficient for this interaction term (γj) shows how the change in the anthropometric measure between the pre- and post-war birth cohorts from province j differ from the corresponding change among men from Seoul.

The regression results reported in <Table 5-4> confirm that there were substantial differences across provinces in the magnitude of height changes between the pre- and post-war birth cohorts. The first column shows that height changes were significantly slower for the conscripts from Inchoen, Gyeonggi, Gangwon, Chungbuk, Chungnam, and Jeonbuk compared to those from Seoul. Controlling father's occupation (Column 2) does not change the results much, at least qualitatively, although the negative coefficient for the interaction term of Chungbuk and post-war cohorts marginally loses statistical significance. If own education is controlled along with father's occupation (Column 3), however, only the disadvantages of Incheon and Jeonbuk remain statistically significant.

The results of regressions for weights, reported in <Table 5-5>, show considerably

large variations in weight changes across provinces. As in the case of height, the results from all three specifications suggest that weight changes among recruits from Incheon were significantly lower than those from Seoul. By contrary, Gwangju, Gangwon, Jeonbuk, Jeonnam, and Gyeongnam all experienced significantly greater increase in the weights of conscripts compared to Seoul, and the results remain unchanged if father's occupation and own education are controlled.

Conclusion

Although it is widely acknowledged that the rapid economic growth in South Korea during the second half of the twentieth century improved the standards of living of the population, it is not fully understood how the living conditions in South Korea changed over time, and what are the major factors that produced the changes. Research on these issues is often seriously limited by shortage of appropriate data, especially for the period between 1945 and 1960. The present study attempts to overcome the limitations of currently available data on standards of living by analyzing a newly collected sample of Korean military records. Using these sources, we have investigated how biological indices of standards of living, such as height, weight, and BMI changed across birth cohorts born between 1946 and 1957. We also examined how changes in anthropometric measures differed by province of residence, father's occupation, and own education.

The mean height of 20-year-old males in South Korea slightly declined from the 1946 birth cohort to those born in 1951, before it rapidly increased across cohorts. As for the average weight, a sharp decline and recovery of weights around the first two years of the Korean War (1950 and 1951) is observed. These results suggest that the Korean War likely affected significantly the anthropometric measures of the birth cohorts who experienced the war in utero or in early childhood.

There were considerably large variations across provinces in the patterns of changes in anthropometric measures as well as the levels of the measures. Generally speaking, men who resided in Seoul and other metropolitan cities (Busan, Daegu, Gwangju, Daejeon, and Ulsan) are taller than those from non-metropolitan provinces. In contrast, men from the majority of non-metropolitan provinces are significantly shorter than those from Seoul. In sharp contrast to the results for height, urban disadvantages in weight are observed.

The results of regression analyses show that the observed provincial differences in anthropometric measures do not disappear even if father's occupation and own education

are controlled. Consistent with the urban advantages found in provincial differences in height, the children of farmers turned out to be shorter that the offspring of non-farmers. Own education is positively associated with height and weight. These results suggest that the observed regional differences in the level and trend of biological standard of living in South Korea prior to the mid-1970s were probably produced by provincial differences in socioeconomic and environmental characteristics.

It will be the next step of this research project to explore what are the major factors that produced the secular changes and regional differences in biological standards of living in South Korea prior to the 1970s. We are currently in the process of collecting and inputting county-level variables that are believed to be associated with net nutritional status of the population, including agricultural production, urbanization, and industrialization. We plan to conduct additional analyses by adding these factors on local environments to the variables on personal characteristics utilized in this study. We anticipate that the results of these further analyses will allow us to determine what socioeconomic changes or policy measures were the major contributors to the improvements of wellbeing of the Korean people.

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Table 2-1| Measures of Public Health Conditions in Korea in the 1950s

	1952	1953	1954	1955	1956	1957	1958	1959
Public health centers	17	17	17	17	17	23	26	66
Health or nutrition counselors	98,426	155,529	157,828	111,285	125,556	173,473	196,443	281,661
Patients per year	103,664	96,574	148,753	124,110	163,018	253,710	278,313	774,133
Home-visit services	17,610	15,135	13,711	14,835	16,981	36,866	43,776	75,664
People with vaccination	182,908	127,734	64,961	174,079	126,220	227,385	432,253	1,496,378
Guides about quarantine	-	-	196	873	1,590	11,710	20,203	22,516
Quarantines conducted	-	-	29	625	441	10,498	11,635	21,425
Tests or examinations	27,057	34,867	114,447	131,077	167,477	356,674	327,417	562,239
Lectures or film shows	15	16	108	101	106	207	201	771
Participants of lectures	1,950	7,570	20,644	22,986	45,987	39,049	-	274,844
Symposiums	20	39	33	55	92	172	189	656
Participants of symposiums	226	106	642	2,047	2,821	9,686	288	3,274
School-visit services	144	2,102	25,597	201	175	471	658	2,527

Source: kosis.kr.

Table 2-2| Public Health Works in Korea

	1950	1951	1952	1953	1954	1955	1956	1957	1958
Number of fumigated buildings (1000)	201	6,133	670	539	642	1,374	1,285	1,145	486
- Public buildings	-	-	223	205	133	217	289	100	60
- Private buildings	-	-	448	334	510	1,157	996	1,045	426
Area of rooms in fumigated buildings (1000 *pyeong*)	-	-	-	-	11,721	24,778	27,216	18,675	10,828
- Public buildings	-	-	-	-	3,878	9,111	12,963	10,683	4,324
- Private buildings	-	-	-	-	7,842	15,667	14,253	7,992	6,504
Number of person disinfected (1000)	5,199	3183	4,400	3,589	8,347	5,492	3,504	3,246	1,489
Number of drains	-	2,766	1,283	745	25,900	25,925	27,377	4,576	27,082
Number of wells sterilized (1000)	33	516	618	233	383	1,127	2,335	813	367
- Public	-	-	160	84	127	372	770	335	130
- Private	-	-	458	148	257	756	1,566	478	237
Number of fumigated roads or drains (1000)	-	-	148	74	98	142	761	96	-
Area of fumigated roads or drains (1000 *pyeong*)	-	-	-	-	1,479	9,905	4,597	2,632	-

Source: kosis.kr.

Table 2-3| Mail Average Body Height by Age and Year

(Unit: cm)

Year	16	17	18	19	20-24	25-29	30-34	35-39	40-49	50-59	60-69
1979	165.5	167.6	166.8	166.8	167.7	167.0	166.1	166	163.9		
1986	166.2	167.0	167.9	168.3	167.7	166.6	167.7	166.8	165.8	166.2	
1992	168.5	170.5	169.9	170.4	169.6	169.3	168.9	168.2	167.1	165.4	
1997	170.1	170.7	171.6	171.6	171.3	171.7	171.3	169.6	167.9	166.5	164.1
2004	170.3	172.5	172.9	173.4	173.8	172.5	171.3	170.7	168.6	166.1	164.4
2010	170.8	173.1	173.2	172.8	173.5	173.6	172.4	171.9	169.2	166.3	166.4
2015	172.1	172.6	173.0	173.1	174.2	173.6	173.7	172.5	170.4	168.2	165.4

Source: Korean Agency for Technology and Standards (2015: 119).

Table 2-4| Female Average Body Height by Age and Year

(Unit: cm)

	16	17	18	19	20-24	25-29	30-34	35-39	40-49	50-59	60-69
1979	155.2	155.5	155.7	155.7	155.5	155.2	153.7	154.2	153.1		
1986	155.9	155.8	156.2	156.4	155.4	155.2	154.5	154.9	154.7	150.0	
1992	156.9	157.8	159.6	159.4	158.8	158.3	156.5	156.2	155.2	153.8	
1997	159.7	159.3	160.0	159.1	160.2	159.3	158.3	157.3	156.7	153.4	151.2
2004	159.6	159.7	160.3	160.2	160.7	159.3	158.1	157.2	156.1	154.3	151.8
2010	159.7	160.5	160.5	159.8	160.4	160.2	160.1	159.0	156.7	154.7	152.3
2015	159.8	159.8	159.4	159.8	160.9	160.8	160.2	160.2	157.0	154.7	152.9

Source: Korean Agency for Technology and Standards (2015: 119).

Table 2-5| Summary of Previous Research on Anthropometric Measures in Korea

	Data	Major indices
Lim et al. (1986)	Related literature published after 1913	Height and weight at age 6, 7, …, 17 in 1913, 1935, 1940, ⋯, 1967 by gender
Hong et al. (1993)	7,761 young females enrolled in *Yonsei* University from 1983 to 1991	Geographic regions, menarcheal age, height and weight at the time of enrollment of girls born between 1963 and 1973
National Statistical Office (1998)	Ministry of Education, *Education Statistical Yearbook*	Height ([Figure 2-10]) and weight at age 6, 11, 14, 17 between 1965 and 1996 by gender
Hwang et al. (2003)	Randomly recruited 1,061 women born between 1920 and 1986 for the Ansan Health Study sample	Menarcheal age and Height at menarche born between 1920 and 1986
Pak (2004)	Korean Agency for Technology and Standards, *Size Korea* (인체치수조사사업) 1997	Height at age 17 in 1960, 1965, ⋯, 2000 by gender
Lee and Park (2005)	Related literature published after 1913	Height and weight at age 6, 7, …, 24 in 1913, 1935, 1940, ⋯, 2000 by gender
Kim et al. (2006)	Several nation-wide studies based on random samples conducted by other researchers in Korea from 1940 to 1995	Height and weight at age 12, 13, …, 24 in 1940, 1953, 1967, ⋯, 1995 by gender
Kim et al. (2008), Choi and Kim (2012)	Nationwide cross-sectional anthropometric survey in 1965, 1975, 1984, 1997, and 2005	Height and weight at 0, 1, …, and 20 in 1965, 1975, 1884, 1997, and 2005 by gender
Schwekendiek and Jun (2010)	Korean Agency for Technology and Standards, *Size Korea* 2004 (raw data) and Korean Medical Insurance Corporation data	Male height at 20 to 39 for the cohorts born between 1954 and 1983
Pak et al. (2011)	Korean Agency for Technology and Standards, *Size Korea* 2004	Age-unadjusted height for birth cohorts from 1935-44 to 1980-84 by gender
Korean Agency for Technology and Standards (2015)	Results of 1st~7th *size Korea* (Tables 5, 6, 7, and 8)	Height (<Table 2-3>, <Table 2-4>) and BMI (<Table 2-6>, <Table 2-7>) of at age 16, 17, …, and 69 in 1979, 1986, 1992, 1997, 2004, 2010, and 2015 by gender
Sohn (2016)	Korean National Health and Nutrition Examination Survey for 2001, 2005, 2007, 2008, …, and 2013	Menarcheal age born between 1941 and 1992; Heights for the cohorts born between 1938 and 1992 at the time of survey by gender

Table 2-6| Male Average BMI by Age and Year

	16	17	18	19	20-24	25-29	30-34	35-39	40-49	50-59	60-69
1979	19.8	20.2	21.1	21.1	21.8	22.1	22.0	22.6	22.0		
1986	20.3	20.5	21.0	21.1	21.5	22.2	22.9	23.4	23.7	22.3	
1992	20.9	21.0	21.2	21.7	22.1	22.7	23.3	23.8	24.1	23.2	
1997	20.6	20.7	21.2	21.8	22.1	23.1	23.1	23.8	24.5	24.3	22.4
2004	21.9	21.9	22.5	22.7	23.0	23.6	24.4	24.8	24.8	25.0	24.4
2010	21.4	22.3	22.4	22.3	22.9	24.0	24.5	25.1	24.8	24.8	24.6
2015	21.6	22.0	22.2	22.7	23.5	24.5	25.3	25.2	25.2	24.9	25.0

Source: Korean Agency for Technology and Standards (2015: 121).

Table 2-7| Female Average BMI by Age and Year

	16	17	18	19	20-24	25-29	30-34	35-39	40-49	50-59	60-69
1979	21.2	21.3	21.9	21.9	21.8	21.2	22	22	22.9		
1986	20.6	20.9	21.2	21.2	21.3	21.4	22.2	22.7	24.3	23.9	
1992	21.3	21.1	20.9	21.1	20.8	21.3	22.3	23	24.2	25.1	
1997	20.5	20.9	20.6	20.6	20.2	20.6	21.9	22.2	23.3	24.3	24.4
2004	21.1	21.3	21.5	20.8	20.7	21.6	22.1	23.1	23.6	25.3	25.3
2010	21.1	21.1	21.1	21	20.6	20.8	21.7	22.1	23.2	24.6	24.9
2015	21.1	21.5	22.2	22.1	21.3	21.5	22.1	22.9	23.6	24.5	25.2

Source: Korean Agency for Technology and Standards (2015: 121).

Table 3-1| Number of Military Records by Year of Birth

Year of Birth	(A) Number of Records Collected	(B) Number of Incomplete Records	(C) Number of Duplicated Records	(D) Number of Records Inputted
1946	1,162	0	4	1,158
1947	1,036	0	5	1,031
1948	1,443	1	1	1,441
1949	1,143	0	23	1,120
1950	1,310	1	5	1,304
1951	1,303	0	43	1,260
1952	1,577	0	2	1,575
1953	1,404	11	35	1,358
1954	1,706	4	6	1,696
1955	1,875	0	52	1,823
1956	2,157	1	18	2,138
1957	2,243	3	29	2,211
Total	18,359	21	223	18,115

Source: Sample of Korean Military Records.

Table 5-1| Correlates of Height at Military Medical Examination (in centimeter)

	Mean	(1)		(2)		(3)	
		∂y/∂x	P-value	∂y/∂x	P-value	∂y/∂x	P-value
Intercept		166.14	<.0001	165.95	<.0001	164.86	<.0001
Province of Residence							
Seoul	0.15047	NI		NI		NI	
Busan	0.05655	-0.0156	0.9369	0.0267	0.8919	0.2381	0.2235
Daegu	0.02922	-0.1864	0.4655	-0.1226	0.6310	0.0948	0.7083
Incheon	0.02025	-0.7475	0.0125	-0.7301	0.0146	-0.5482	0.0647
Gwangju	0.01251	-0.1887	0.6122	-0.1639	0.6593	0.0712	0.8469
Daejeon	0.01257	0.0073	0.9842	0.0559	0.8803	0.1397	0.7042
Ulsan	0.01257	0.1050	0.7774	0.2276	0.5401	0.4909	0.1832
Gyeonggi	0.07592	-0.6559	0.0002	-0.5571	0.0018	-0.2212	0.2140
Gangwon	0.04333	-0.7610	0.0005	-0.6739	0.0020	-0.2845	0.1913
Chungbuk	0.04528	-0.4905	0.0219	-0.3857	0.0729	-0.0795	0.7104
Chungnam	0.08406	-0.3089	0.0719	-0.1801	0.3002	0.2252	0.1957
Jeonbuk	0.05626	-0.6653	0.0007	-0.5703	0.0041	-0.2942	0.1370
Jeonnam	0.09179	-0.6371	0.0001	-0.5094	0.0026	-0.0798	0.6384
Gyeongbuk	0.11860	-0.5538	0.0003	-0.4261	0.0065	-0.0750	0.6321
Gyeongnam	0.11340	0.0848	0.5886	0.2099	0.1850	0.5621	0.0004
Jeju	0.00431	-1.5826	0.0106	-1.4900	0.0161	-1.2151	0.0479
Province missing	0.06830	-0.1786	0.3376	-0.0864	0.6444	0.2325	0.2127
Father's Occupation							
Farmer	0.38896			NI		NI	
Professional	0.00903			1.6767	<.0001	1.0420	0.0142
Clerical	0.03323			1.3990	<.0001	0.7309	0.0016
Service	0.07367			0.4880	0.0027	0.1492	0.3590
Manual	0.03105			0.0667	0.7784	-0.0212	0.9283
No job	0.20142			-0.0135	0.9032	-0.1432	0.1931
Father absent	0.20372			0.0565	0.6010	0.0562	0.5996
Education							
Primary or less	0.24233					NI	
Middle school	0.28188					0.6723	<.0001
High school	0.36246					1.4197	<.0001
College or higher	0.10856					2.2659	<.0001
Education missing	0.00478					1.1572	0.0461
R-square		0.0225		0.0259		0.0423	
F-value		14.40		13.60		20.16	
P-value		<.0001		<.0001		<.0001	

Source: Sample of Korean Military Records.

Table 5-2| Correlates of Weight at Military Medical Examination (in kilogram)

	Mean	(1)		(2)		(3)	
		∂y/∂x	P-value	∂y/∂x	P-value	∂y/∂x	P-value
Intercept		57.84	<.0001	57.96	<.0001	57.60	<.0001
Province of Residence							
Seoul	0.15047	NI		NI		NI	
Busan	0.05655	0.0039	0.9853	0.0353	0.8689	0.1566	0.4637
Daegu	0.02922	0.2120	0.4425	0.2455	0.3741	0.3254	0.2384
Incheon	0.02025	-0.9344	0.0039	-0.9497	0.0034	-0.8652	0.0075
Gwangju	0.01251	0.1182	0.7709	0.1029	0.7998	0.1936	0.6331
Daejeon	0.01257	0.2412	0.5436	0.2555	0.5200	0.2608	0.5107
Ulsan	0.01257	0.7453	0.0634	0.7243	0.0717	0.8872	0.0273
Gyeonggi	0.07592	0.1283	0.5057	0.0937	0.6291	0.2645	0.1748
Gangwon	0.04333	0.5726	0.0147	0.5236	0.0264	0.7081	0.0028
Chungbuk	0.04528	0.2647	0.2538	0.2225	0.3404	0.3710	0.1125
Chungnam	0.08406	0.8332	<.0001	0.7659	<.0001	0.9480	<.0001
Jeonbuk	0.05626	0.7667	0.0003	0.6884	0.0013	0.8158	0.0001
Jeonnam	0.09179	1.2150	<.0001	1.1461	<.0001	1.3328	<.0001
Gyeongbuk	0.11860	0.3722	0.0265	0.3545	0.0368	0.5209	0.0023
Gyeongnam	0.11340	0.9543	<.0001	0.9175	<.0001	1.0836	<.0001
Jeju	0.00431	1.4308	0.0354	1.3575	0.0462	1.5198	0.0254
Province missing	0.06830	0.4328	0.0322	0.3950	0.0520	0.5538	0.0066
Father's Occupation							
Farmer	0.38896			NI		NI	
Professional	0.00903			0.2128	0.6464	-0.1445	0.7561
Clerical	0.03323			0.0253	0.9183	-0.3353	0.1807
Service	0.07367			-0.0948	0.5907	-0.2525	0.1540
Manual	0.03105			-0.6848	0.0078	-0.7328	0.0044
No job	0.20142			-0.4050	0.0008	-0.4733	<.0001
Father absent	0.20372			-0.1455	0.2151	-0.1560	0.1832
Education							
Primary or less	0.24233					NI	
Middle school	0.28188					0.0952	0.4323
High school	0.36246					0.3254	0.0053
College or higher	0.10856					1.2718	<.0001
Education missing	0.00478					1.0812	0.0858
R-square		0.0091		0.0101		0.0141	
F-value		5.75		5.24		6.52	
P-value		<.0001		<.0001		<.0001	

Source: Sample of Korean Military Records.

Table 5-3| Correlates of Height and Weight: Comparison between 1946-48 and 1955-57 (Model 2 only)

	Height				Weight			
	1946-48		1955-57		1946-48		1955-57	
	∂y/∂x	P-value	∂y/∂x	P-value	∂y/∂x	P-value	∂y/∂x	P-value
Intercept	165.61	<.0001	167.56	<.0001	57.93	<.0001	58.20	<.0001
Province of Residence								
Seoul	NI		NI		NI		NI	
Busan	0.2041	0.7049	-0.0194	0.9488	0.2123	0.7209	0.1449	0.6595
Daegu	-0.5836	0.3687	-0.4419	0.2651	-0.2678	0.7043	0.5350	0.2156
Incheon	-0.5645	0.4308	-1.0048	0.0465	-0.8659	0.2979	-1.4684	0.0072
Gwangju	0.3115	0.7500	0.6688	0.2466	-1.5309	0.1791	1.1246	0.0733
Daejeon	0.0996	0.9295	0.0966	0.8611	-0.1458	0.9000	0.3837	0.5226
Ulsan	-0.2009	0.8325	-0.3107	0.6142	-0.3087	0.7698	0.5010	0.4549
Gyeonggi	-0.0575	0.8984	-0.6211	0.0244	0.4787	0.3474	-0.0052	0.9862
Gangwon	-1.0641	0.0538	-0.6861	0.0368	0.6010	0.3124	0.7536	0.0348
Chungbuk	-0.8178	0.1056	-0.6205	0.0837	0.4132	0.4613	-0.1943	0.6183
Chungnam	0.3724	0.3864	-0.7466	0.0100	0.9954	0.0374	0.3997	0.2039
Jeonbuk	-0.9541	0.0415	-0.8977	0.0058	0.7233	0.1521	0.8138	0.0212
Jeonnam	0.0954	0.8245	-0.3088	0.2664	0.6977	0.1437	1.6766	<.0001
Gyeongbuk	-0.1024	0.7936	-0.6480	0.0135	0.8927	0.0402	-0.0409	0.8863
Gyeongnam	0.2974	0.4459	0.2295	0.3860	0.9178	0.0349	0.8003	0.0054
Jeju	-2.2485	0.1034	-0.1780	0.9278	3.2502	0.0341	2.6898	0.2080
Province missing	0.3092	0.4126	-0.7057	0.0923	0.6513	0.1225	0.1292	0.7758
Father's Occupation								
Farmer	NI		NI		NI		NI	
Professional	1.2614	0.2650	1.3976	0.0263	-0.9372	0.4663	0.7347	0.2829
Clerical	1.6317	0.0093	1.4957	<.0001	0.0823	0.9031	0.1959	0.5810
Service	0.5261	0.2109	0.3952	0.1032	-0.5154	0.2728	0.0995	0.7054
Manual	1.7694	0.0044	-0.2698	0.4212	-0.7292	0.2851	-0.5950	0.1025
No job	0.3017	0.3330	-0.1951	0.3299	-0.1191	0.7305	-0.4536	0.0375
Father absent	0.0393	0.8686	-0.1943	0.3020	-0.3032	0.2517	-0.2538	0.2148
R-square	0.0132		0.0118		0.0091		0.0133	
F-value	1.81		3.26		1.25		3.69	
P-value	0.0121		<.0001		0.1929		<.0001	

Source: Sample of Korean Military Records.

Table 5-4| Provincial Differences in Height Change between 1946-48 and 1955-57

	Mean	(1)		(2)		(3)	
		∂y/∂x	P-value	∂y/∂x	P-value	∂y/∂x	P-value
Intercept		165.71	<.0001	165.65	<.0001	164.66	<.0001
B5557 (Born in 1955-57)	0.66763	1.9971	<.0001	1.8153	<.0001	1.5322	<.0001
Province & Born in 1955-57							
Seoul × B5557	0.11785	NI		NI		NI	
Busan × B5557	0.04534	-0.1070	0.7242	-0.0386	0.8987	0.2094	0.4868
Daegu × B5557	0.02273	-0.5826	0.1427	-0.4644	0.2433	-0.1306	0.7414
Incheon × B5557	0.01297	-1.0526	0.0381	-1.0287	0.0425	-0.9940	0.0481
Gwangju × B5557	0.00965	0.6671	0.2509	0.6727	0.2462	0.7705	0.1805
Daejeon × B5557	0.01064	0.0227	0.9674	0.0905	0.8704	0.1576	0.7745
Ulsan × B5557	0.00843	-0.4894	0.4289	-0.2858	0.6442	-0.1206	0.8442
Gyeonggi × B5557	0.05976	-0.7499	0.0065	-0.6154	0.0261	-0.3436	0.2117
Gangwon × B5557	0.03647	-0.8044	0.0144	-0.6654	0.0436	-0.2814	0.3911
Chungbuk × B5557	0.02927	-0.7073	0.0484	-0.5824	0.1053	-0.2974	0.4051
Chungnam × B5557	0.05344	-0.8559	0.0028	-0.6914	0.0169	-0.2964	0.3045
Jeonbuk × B5557	0.03803	-0.9514	0.0033	-0.8466	0.0093	-0.6681	0.0387
Jeonnam × B5557	0.06042	-0.4414	0.1079	-0.2609	0.3474	0.0316	0.9091
Gyeongbuk × B5557	0.07206	-0.8114	0.0018	-0.6364	0.0153	-0.3067	0.2408
Gyeongnam × B5557	0.06984	0.0792	0.7623	0.2651	0.3167	0.5750	0.0292
Jeju × B5557	0.00078	-0.3494	0.8597	-0.0958	0.9613	-0.3613	0.8535
Province missing × B5557	0.01996	-0.8065	0.0548	-0.6730	0.1096	-0.3657	0.3814
Father's Occupation							
Farmer	0.41120			NI		NI	
Professional	0.01020			1.4195	0.0098	0.8415	0.1243
Clerical	0.03936			1.5674	<.0001	0.8886	0.0025
Service	0.08503			0.4566	0.0284	0.0726	0.7282
Manual	0.03825			0.2225	0.4493	0.0946	0.7457
No job	0.14745			-0.0199	0.9055	-0.1980	0.2353
Father absent	0.19878			-0.0879	0.5503	-0.0699	0.6321
Education							
Primary or less	0.23603					NI	
Middle school	0.28160					1.0004	<.0001
High school	0.36264					1.5294	<.0001
College or higher	0.11397					2.3385	<.0001
Education missing	0.00577					1.5627	0.0311
R-square		0.0231		0.0276		0.0449	
F-value		12.51		11.08		15.66	
P-value		<.0001		<.0001		<.0001	

Source: Sample of Korean Military Records

Note: A subsample of males born in the pre-war period (1946 to 1948) and the post-war period (1955-1957) is included in the analyses. B5557 denotes a dummy variable indicating that the person was born between 1955 and 1957.

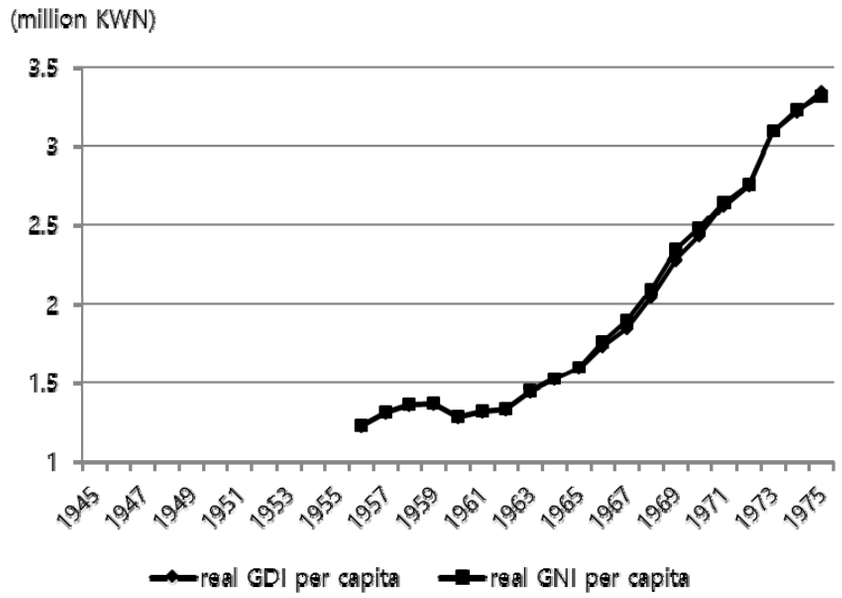
Table 5-5| Provincial Differences in Weight Change between 1946-48 and 1955-57

	Mean	(1)		(2)		(3)	
		∂y/∂x	P-value	∂y/∂x	P-value	∂y/∂x	P-value
Intercept		58.33	<.0001	58.47	<.0001	58.13	<.0001
B5557 (Born in 1955-57)	0.66763	-0.2325	0.2523	-0.1937	0.3505	-0.2991	0.1517
Province & Born in 1955-57							
Seoul × B5557	0.11785	NI		NI		NI	
Busan × B5557	0.04534	0.0762	0.8184	0.1261	0.7045	0.2606	0.4333
Daegu × B5557	0.02273	0.4319	0.3211	0.5079	0.2448	0.6206	0.1555
Incheon × B5557	0.01297	-1.4929	0.0069	-1.4628	0.0082	-1.4979	0.0067
Gwangju × B5557	0.00965	1.1353	0.0739	1.1188	0.0782	1.1101	0.0801
Daejeon × B5557	0.01064	0.3481	0.5663	0.3667	0.5458	0.3265	0.5902
Ulsan × B5557	0.00843	0.4712	0.4860	0.4482	0.5085	0.5561	0.4112
Gyeonggi × B5557	0.05976	-0.0431	0.8862	-0.0442	0.8839	0.1022	0.7358
Gangwon × B5557	0.03647	0.7494	0.0368	0.7194	0.0460	0.8870	0.0141
Chungbuk × B5557	0.02927	-0.1779	0.6497	-0.2403	0.5415	-0.0952	0.8090
Chungnam × B5557	0.05344	0.4478	0.1516	0.3550	0.2620	0.5253	0.0982
Jeonbuk × B5557	0.03803	0.8793	0.0128	0.7851	0.0275	0.8677	0.0147
Jeonnam × B5557	0.06042	1.7058	<.0001	1.6318	<.0001	1.7720	<.0001
Gyeongbuk × B5557	0.07206	-0.1062	0.7087	-0.1012	0.7251	0.0572	0.8429
Gyeongnam × B5557	0.06984	0.8058	0.0049	0.7579	0.0089	0.9121	0.0017
Jeju × B5557	0.00078	2.7626	0.2010	2.6254	0.2244	2.4366	0.2586
Province missing × B5557	0.01996	0.1445	0.7519	0.0945	0.8367	0.2422	0.5972
Father's Occupation							
Farmer	0.41120			NI		NI	
Professional	0.01020			0.2529	0.6761	-0.08755	0.8853
Clerical	0.03936			0.0988	0.7534	-0.30928	0.3352
Service	0.08503			-0.1378	0.5461	-0.32726	0.1556
Manual	0.03825			-0.7326	0.0224	-0.80695	0.0118
No job	0.14745			-0.4030	0.0282	-0.51008	0.0056
Father absent	0.19878			-0.2912	0.0711	-0.29430	0.0677
Education							
Primary or less	0.23603					NI	
Middle school	0.28160					0.2806	0.0950
High school	0.36264					0.4015	0.0133
College or higher	0.11397					1.4022	<.0001
Education missing	0.00577					1.4663	0.0666
R-square		0.0077		0.0090		0.0135	
F-value		4.14		3.54		4.57	
P-value		<.0001		<.0001		<.0001	

Source: Sample of Korean Military Records.

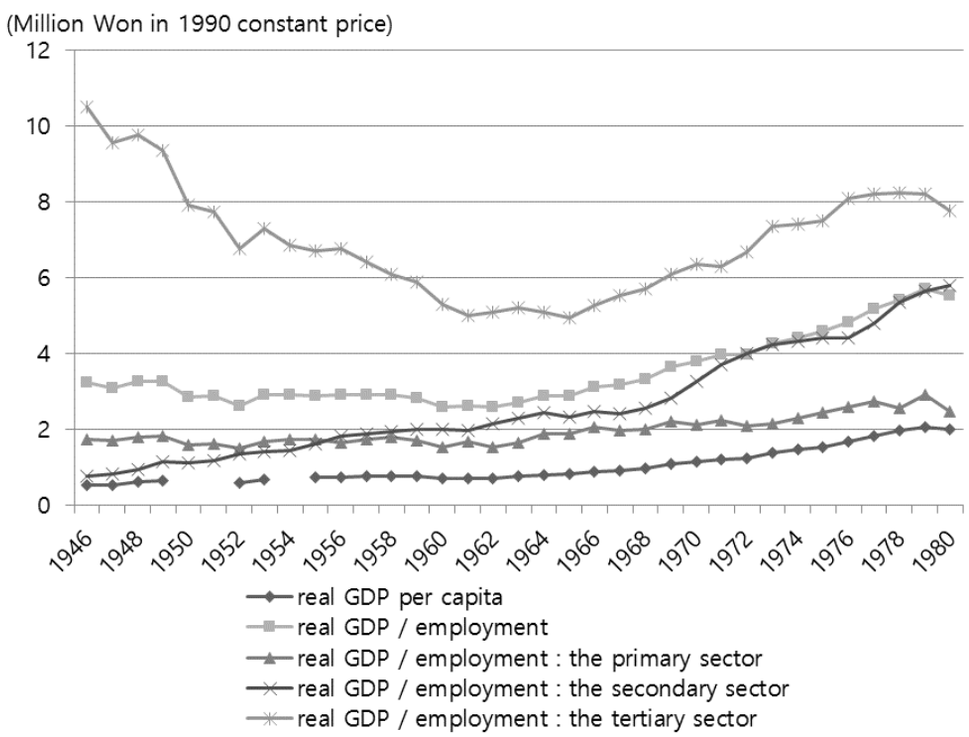
Note: A subsample of males born in the pre-war period (1946 to 1948) and the post-war period (1955-1957) is included in the analyses. B5557 denotes a dummy variable indicating that the person was born between 1955 and 1957.

Figure 2-1| Real GDI and GNI per Capita (base = 2010)



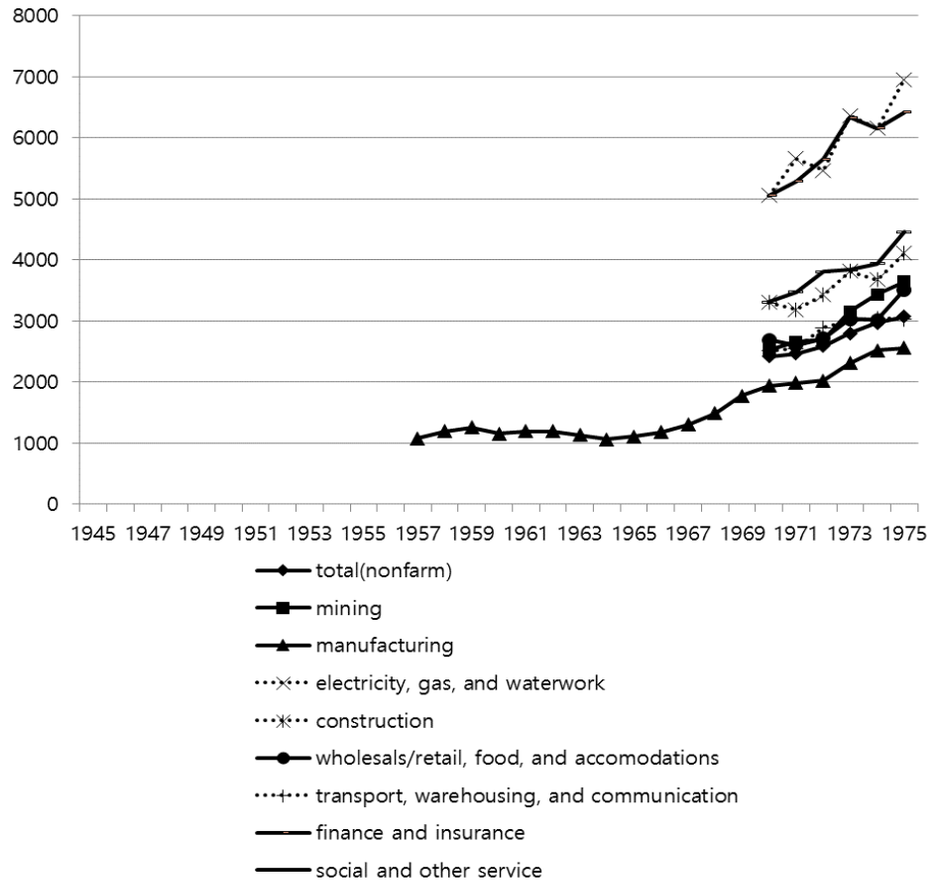
Sources: Real GDI and GNI were obtained from kosis.kr, mid-year estimated population from National Statistical Office (1998: 85).
Note: Real GDI (GNI) per capita = real GDI (GNI) / mid-year estimated population.

Figure 2-2| Real GDP per Employment by Sector



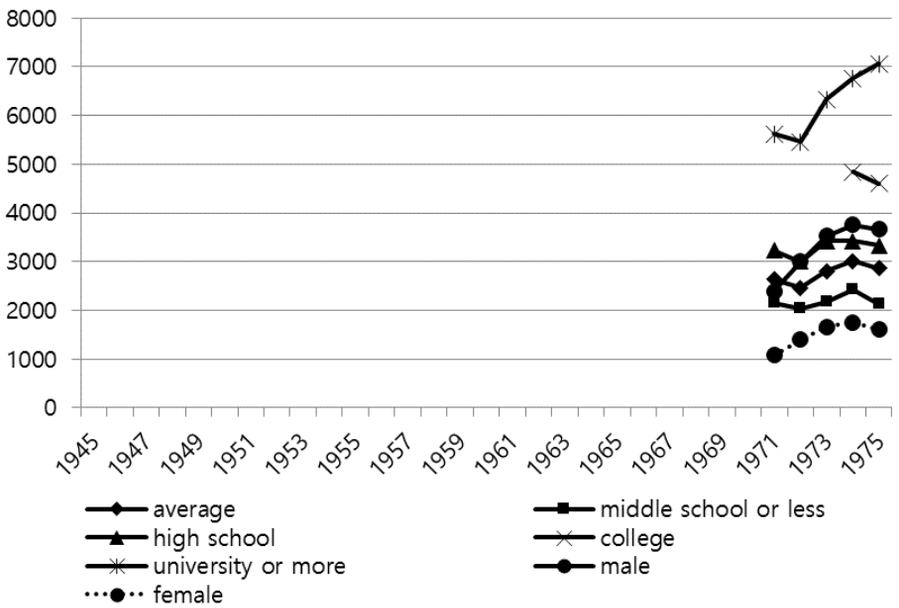
Sources: Real GDP and employment by the sector were drawn from Pyo (2001: 96); population from Pyo (2001: 110).
Notes: Real GDP per capita (employment) = real GDP / population (employment); census population was used to calculate the real GDP per capita until 1959, and after 1960, mid-year population was used.

Figure 2-3| Regular Employees' Real Monthly Wage by Sector



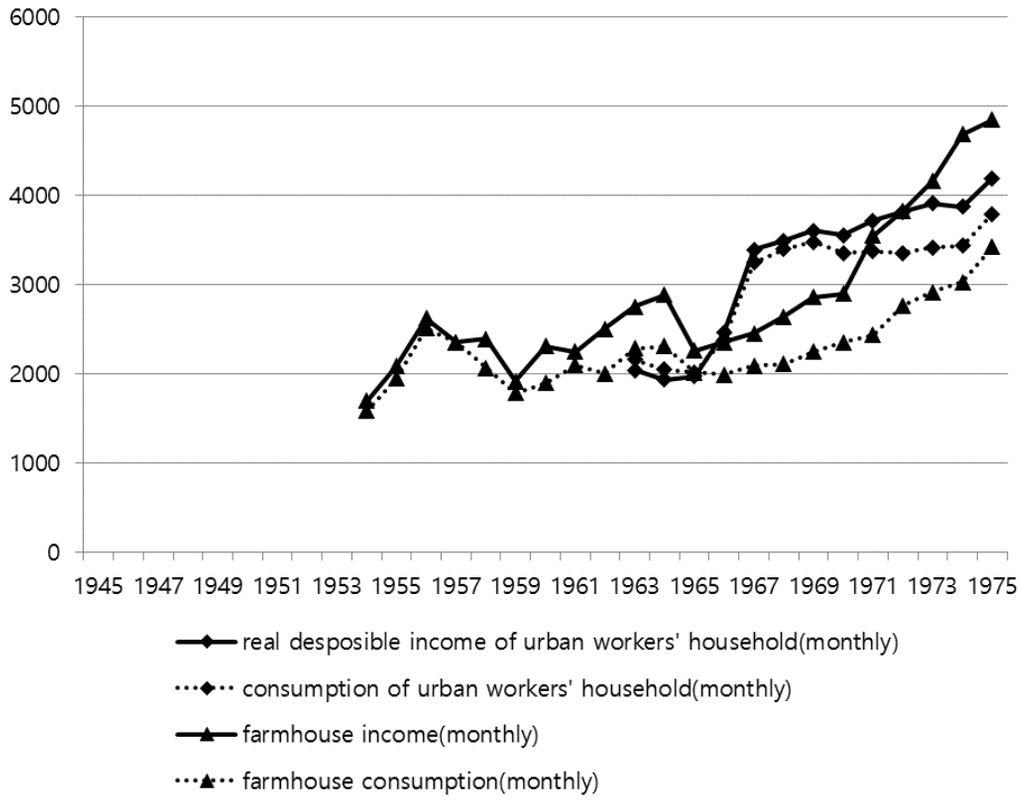
Sources: Nominal wages were drawn from National Statistical Office (1998: 105) and Bank of Korea (2005: 72), CPI from Bank of Korea (2005: 83).
Note: real wage = nominal wage (monthly average, Won) / CPI (2000=100).

Figure 2-4| Real March Monthly Wages by Education and Gender



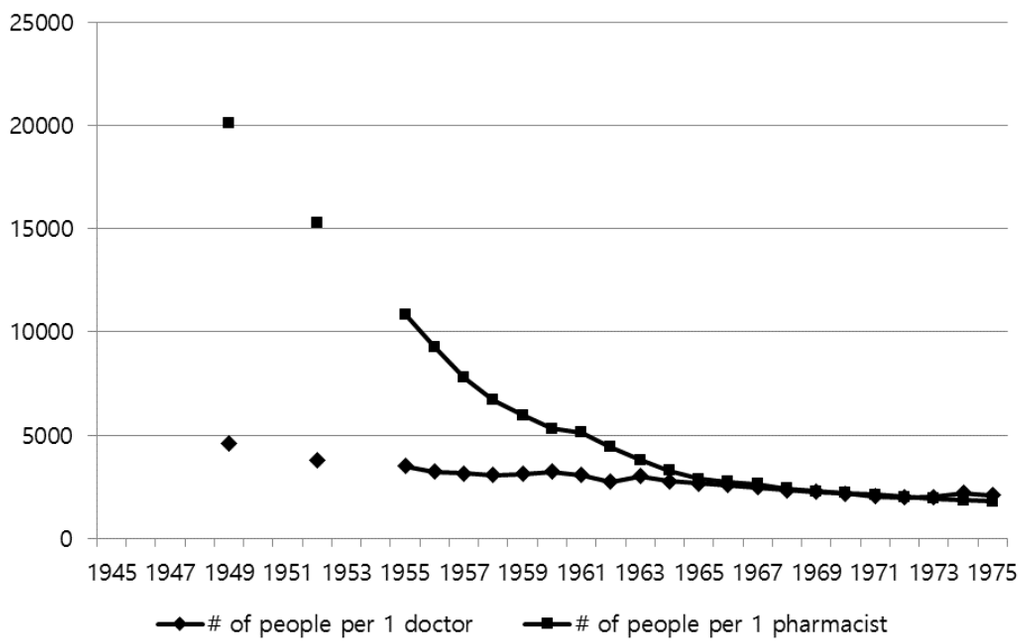
Sources: Nominal wages were drawn from National Statistical Office (1998: 106), CPI from Bank of Korea (2005:83).
Note: real wage = nominal wage (Won) / CPI (2000=100).

Figure 2-5| Real Household Income and Consumption Expenditure



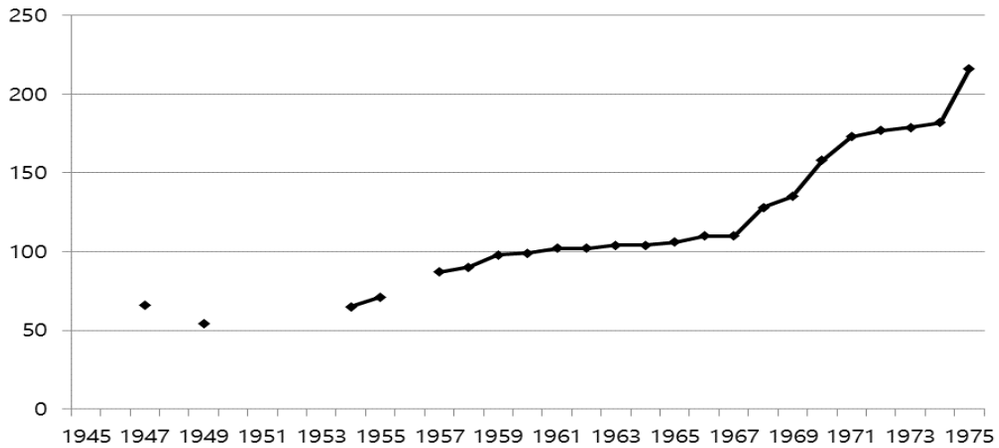
Sources: Nominal values for nonfarm households were drawn from National Statistical Office (1998: 111), nominal values for farm households from National Statistical Office (1998: 135), and CPI from Bank of Korea (2005: 83).
Notes: real income or consumption = nominal income or consumption (Won) / CPI (2000=100).

Figure 2-6| Number of Persons per Health Care Provider



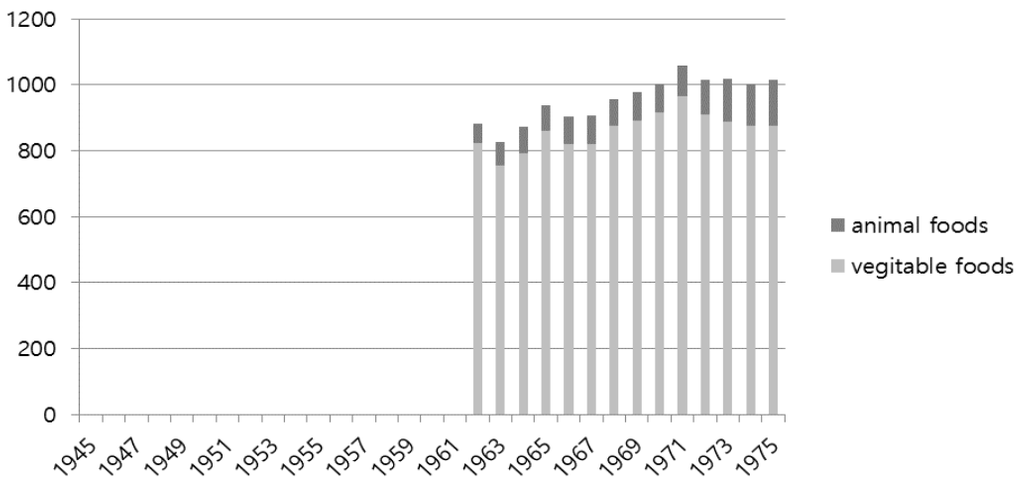
Source: National Statistical Office (1998: 234).

Figure 2-7| Daily Water Supply per Person (Litre)



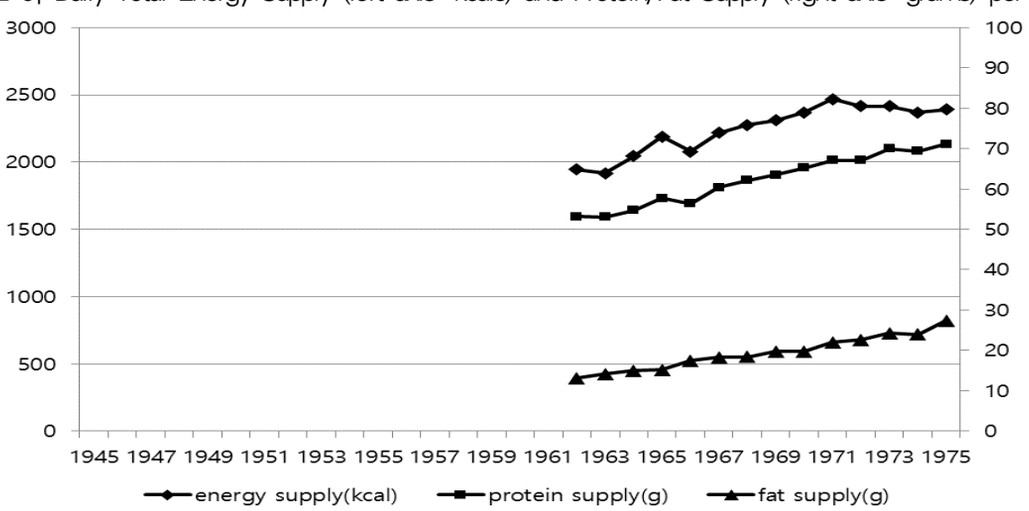
Source: National Statistical Office (1998: 247).

Figure 2-8| Daily Food Supply per Person (gram)



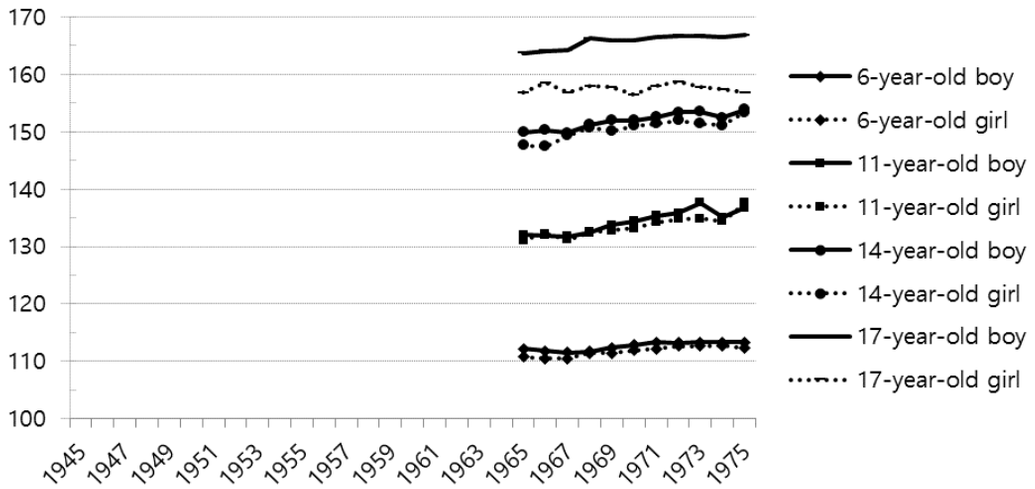
Source: National Statistical Office (1998: 238).

Figure 2-9| Daily Total Energy Supply (left axis: kcals) and Protein/Fat Supply (right axis: grams) per Person



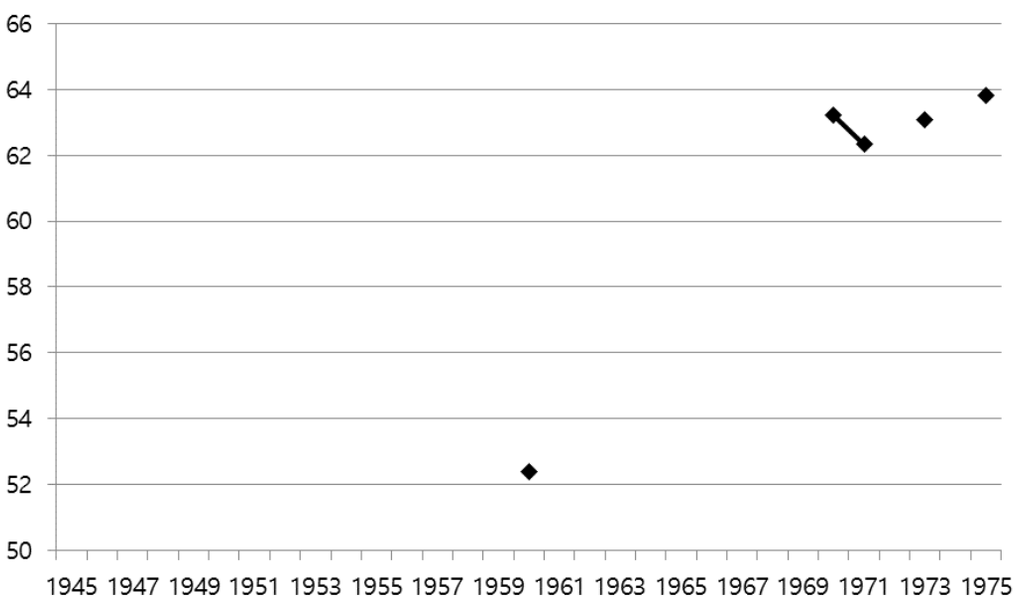
Source: National Statistical Office (1998: 239).

Figure 2-10| Height by Age and Gender (cm)



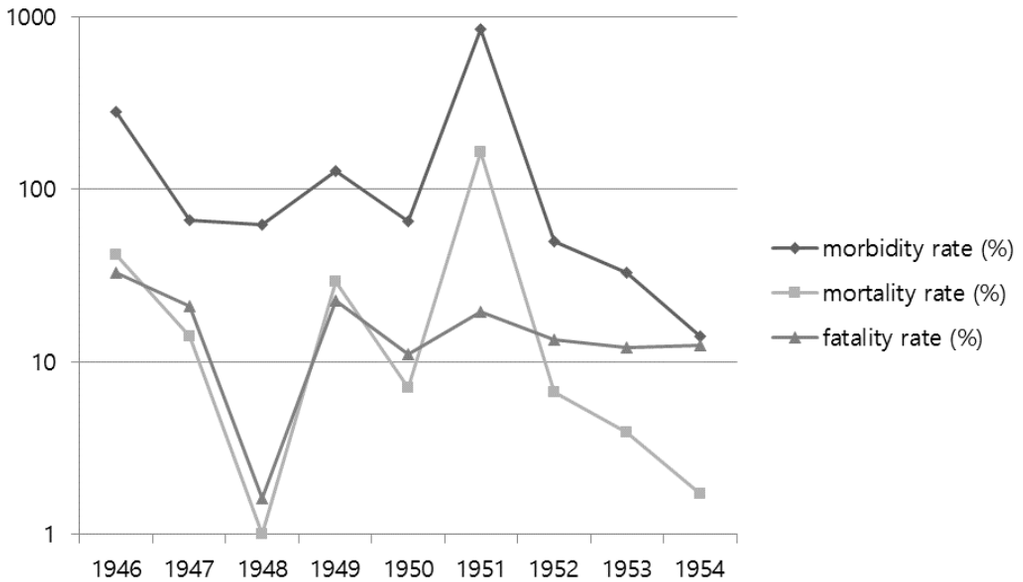
Source: National Statistical Office (1998: 240).

Figure 2-11| Estimated Life Expectancy in South Korea



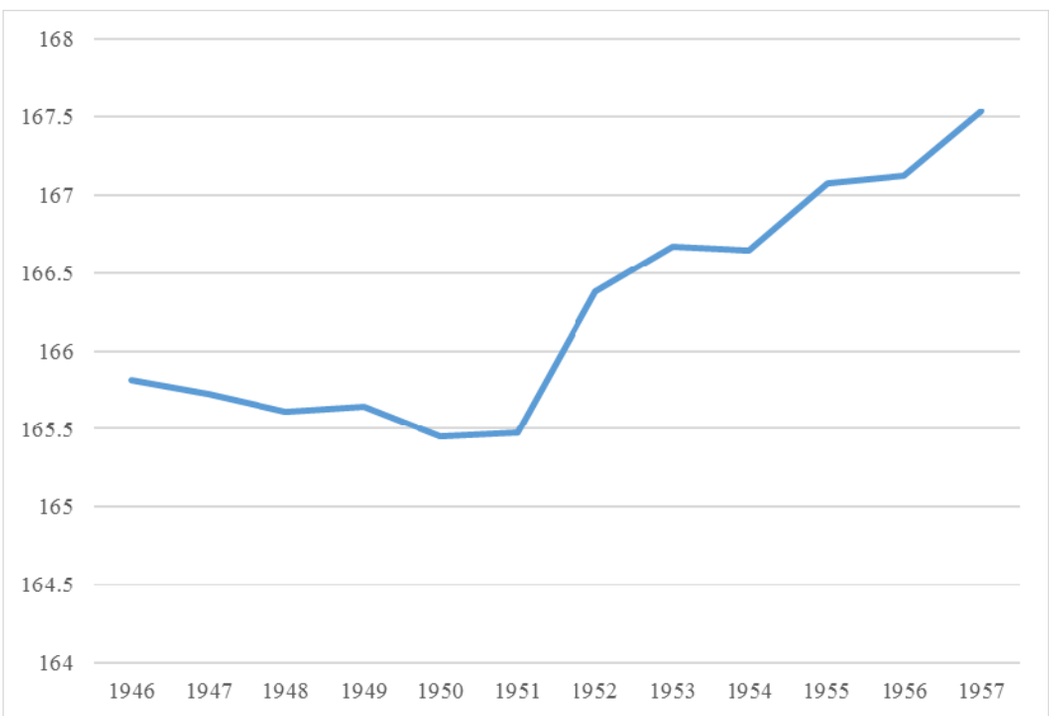
Source: National Statistical Office (1998: 94) for 1960 and 1970, Bank of Korea (2005:91) for 1971, 1973, 1975.

Figure 2-12| Rate of Morbidity, Mortality, and Fatality Caused by Infectious Diseases (log-scale)



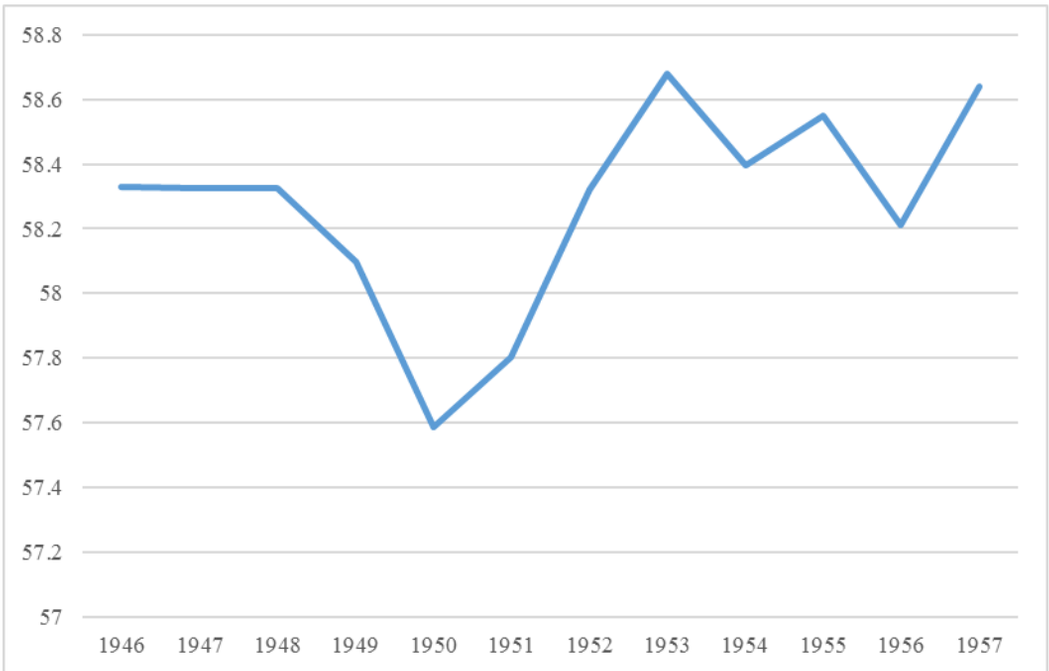
Source: kosis.kr.

Figure 4-1| Average Height by Year of Birth



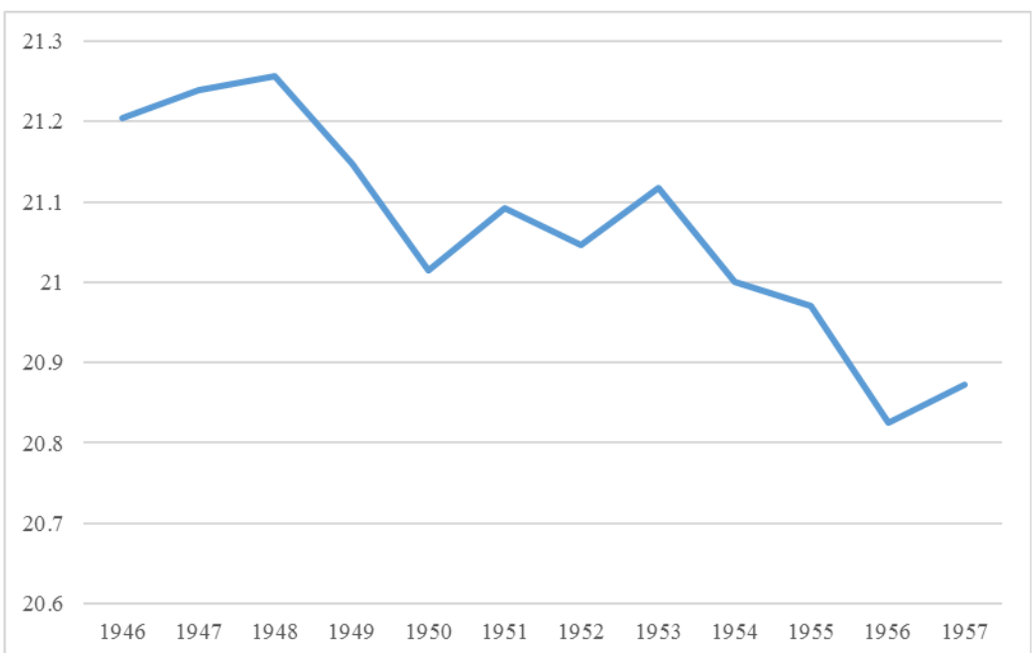
Source: Sample of Korean Military Records.

Figure 4-2| Average Weight by Year of Birth



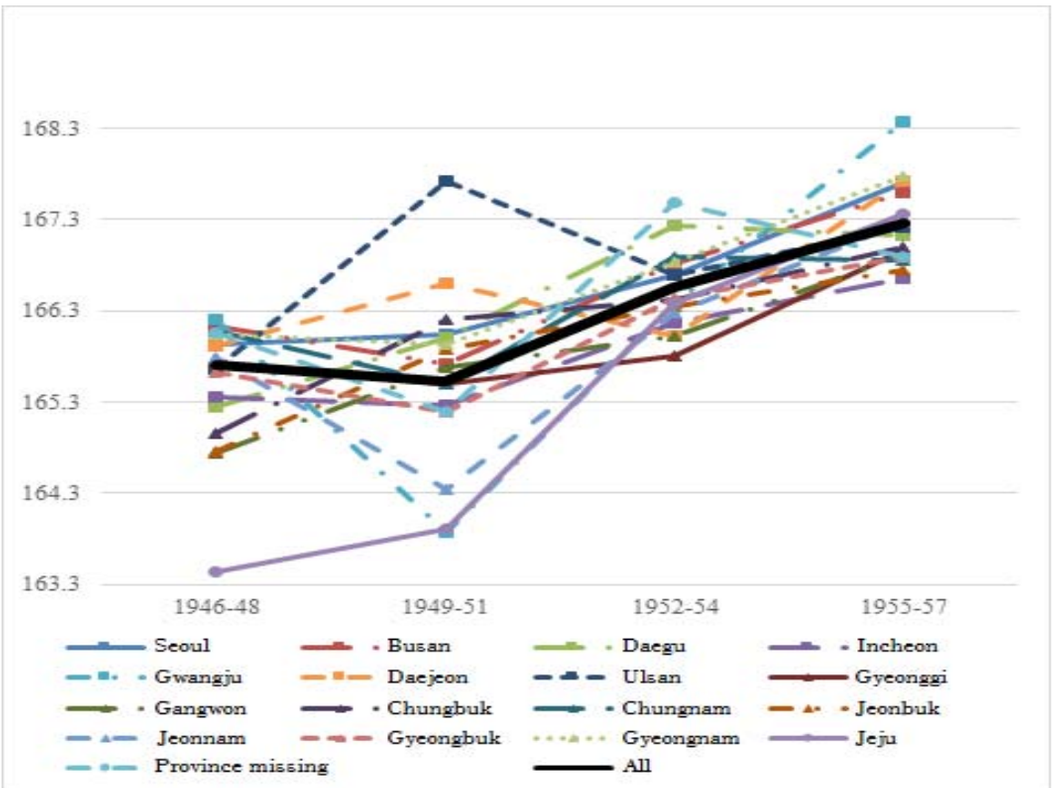
Source: Sample of Korean Military Records.

Figure 4-3| Average BMI by Year of Birth



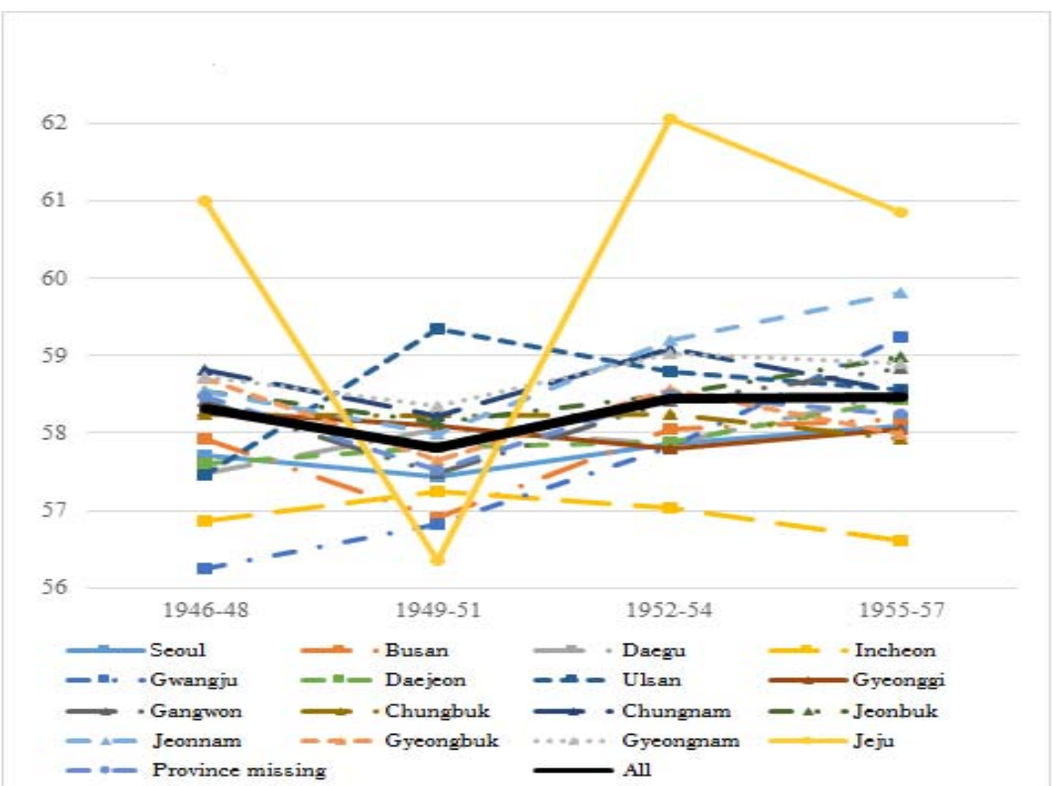
Source: Sample of Korean Military Records.

Figure 4-4| Average Height by Year of Birth and Province



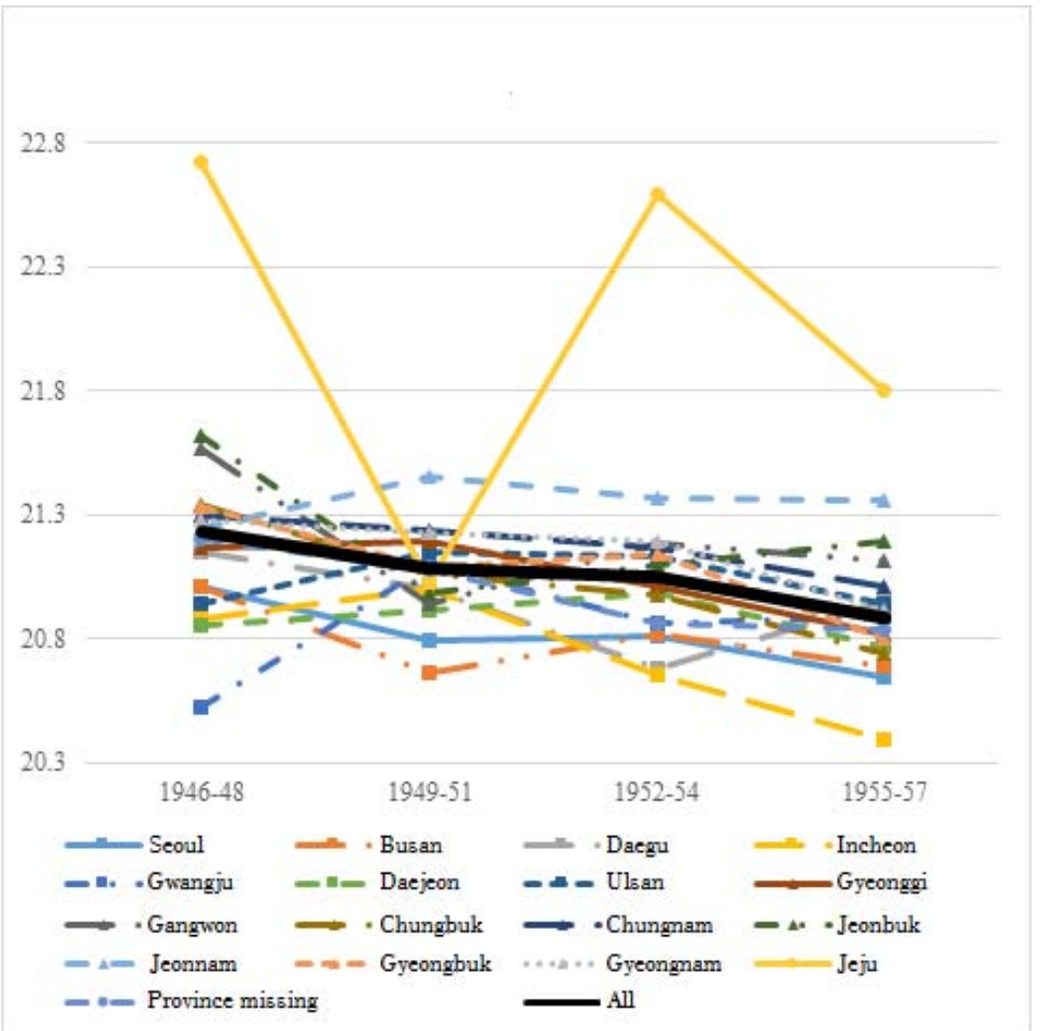
Source: Sample of Korean Military Records.

Figure 4-5| Average Weight by Year of Birth and Province



Source: Sample of Korean Military Records.

Figure 4-6| Average BMI by Year of Birth and Province



Source: Sample of Korean Military Records.

Appendix

Table 1| Height, Weight, and BMI by year of birth

Year	Height (cm)	Weight (kg)	BMI
1946	165.8136	58.3311	21.2038
1947	165.8257	58.3253	21.2392
1948	165.6146	58.3250	21.2570
1949	165.6486	58.0972	21.1470
1950	165.4527	57.5854	21.0152
1951	165.4775	57.8042	21.0925
1952	166.3820	58.3223	21.0458
1953	166.6688	58.6782	21.1175
1954	166.6437	58.3964	21.0002
1955	167.0716	58.5483	20.9705
1956	167.1225	58.2104	20.82511957167.537158.639720.8721

Source: Sample of Korean Military Records.

Table 2| Height by Year of Birth and Province

Province	1946-48	1949-51	1952-54	1955-57
All	165.7094	165.5193	166.5636	167.2543
Seoul	165.9406	166.0446	166.6859	167.7065
Busan	166.1387	165.7193	166.8162	167.5995
Daegu	165.2487	166.0078	167.2385	167.1239
Incheon	165.3629	165.2708	166.1641	166.6538
Gwangju	166.2000	163.8810	166.3788	168.3736
Daejeon	165.9174	166.6049	166.0283	167.7292
Ulsan	165.6606	167.7225	166.6953	167.2171
Gyeonggi	165.7159	165.4965	165.8167	166.9566
Gangwon	164.7398	165.6865	166.0277	166.9021
Chungbuk	164.9533	166.1976	166.4212	166.9992
Chungnam	166.0821	165.4932	166.8908	166.8506
Jeonbuk	164.7532	165.8816	166.3429	166.7551
Jeonnam	165.7835	164.3441	166.2713	167.2651
Gyeongbuk	165.6325	165.1938	166.4389	166.8951
Gyeongnam	166.0365	165.9288	166.8442	167.7857
Jeju	163.4333	163.9114	166.3938	167.3571
Province missing	166.0618	165.1907	167.4823	166.9000

Source: Sample of Korean Military Records.

Table 3| Weight by Year of Birth and Province

Province	1946-48	1949-51	1952-54	1955-57
All	58.3271	57.8140	58.4543	58.4637
Seoul	57.7075	57.4385	57.8521	58.0946
Busan	57.9198	56.9000	58.0550	58.1708
Daegu	57.4793	58.0600	57.8686	58.5265
Incheon	56.8696	57.2453	57.0406	56.6017
Gwangju	56.2464	56.8125	57.8222	59.2299
Daejeon	57.6037	57.8190	57.8889	58.4427
Ulsan	57.4485	59.3524	58.8016	58.5658
Gyeonggi	58.2772	58.0895	57.7888	58.0515
Gangwon	58.4125	57.4830	58.4211	58.8439
Chungbuk	58.2393	58.2242	58.2399	57.9167
Chungnam	58.8139	58.2142	59.0971	58.5424
Jeonbuk	58.5459	58.1433	58.4952	58.9738
Jeonnam	58.5364	57.9832	59.2000	59.8004
Gyeongbuk	58.7145	57.6535	58.5544	57.9884
Gyeongnam	58.7323	58.3583	59.0174	58.9003
Jeju	61.0000	56.3515	62.0625	60.8571
Province missing	58.4664	57.5285	58.5073	58.2390

Source: Sample of Korean Military Records.

Table 4| BMI by Year of Birth and Province

Province	1946-48	1949-51	1952-54	1955-57
All	21.2351	21.0808	21.0499	20.8851
Seoul	21.0084	20.7958	20.8076	20.6468
Busan	21.0113	20.6622	20.8220	20.6854
Daegu	21.1462	20.9980	20.6840	20.9482
Incheon	20.8761	21.0009	20.6511	20.3908
Gwangju	20.5286	21.1002	20.8610	20.8856
Daejeon	20.8579	20.9162	20.9813	20.7638
Ulsan	20.9421	21.1454	21.1335	20.9390
Gyeonggi	21.1633	21.1929	21.0128	20.8226
Gangwon	21.5676	20.9394	21.1831	21.1115
Chungbuk	21.3395	21.0612	20.9763	20.7378
Chungnam	21.3015	21.2389	21.1666	21.0116
Jeonbuk	21.6146	20.9813	21.0965	21.1958
Jeonnam	21.2416	21.4561	21.3710	21.3550
Gyeongbuk	21.3307	21.0885	21.1399	20.7999
Gyeongnam	21.2806	21.2249	21.1906	20.9115
Jeju	22.7174	21.0299	22.5873	21.8019
Province missing	21.2045	21.0824	20.8627	20.8396

Source: Sample of Korean Military Records.